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Technology Evaluation Report: SITE (Superfund Innovative Technology Evaluation) Program Demonstration Test The American Combustion Pyretron Thermal Destruction System at the U.S. EPA's (Environmental Protection Agency's) Combustion Research Facility

Acurex Corp., Jefferson, AR

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SITE

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A series of demonstration tests of the American Combustion, Inc., Thermal Destruction System was performed under the SITE program. This oxygen-enhanced combustion system was retrofit to the rotary kiln incinerator at EPA's Combustion Research Facility. This system's performance was tested firing contaminated soil from the Stringfellow Superfund Site, both alone and mixed with a coal tar waste (K087). Comparative performance with conventional incinerator operation was also tested.

Compliance with the incinerator performance standards of 99.99 percent principal organic hazardous constituents (POHC) destruction and removal efficiency and particulate emissions of less than 180 mg/dscm at 7 percent O_2 was measured for all tests. The Pyretron system was capable of in-compliance performance at double the mixed waste feedrate and at a 60-percent increase in batch waste charge mass than possible with conventional incineration. Scrubber blowdown and kiln ash contained no detectable levels of any of the POHCs chosen.

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FOREWORD

The Superfund Innovative Technology Evaluation (SITE) program was authorized in the 1986 Superfund amendments. The program is a joint effort between EPA's Office of Research and Development and Office of Solid Waste and Emergency Response. The purpose of the program is to assist the development of hazardous waste treatment technologies necessary to implement new cleanup standards which require greater reliance on permanent remedies. This is accomplished through technology demonstrations which are designed to provide engineering and cost data on selected technologies.

This project consists of an analysis of American Combustion's proprietary air/oxygen/fuel burner and represents the third field demonstration in the SITE program. The technology demonstration took place at the USEPA's Combustion Research Facility in Jefferson, Arkansas. The demonstration effort was directed at obtaining information on the performance and cost of the process for use in assessments at other sites. Documentation will consist of two reports. This Technology Evaluation Report describes the field activities and laboratory results. An Applications Analysis will follow and provide an interpretation of the data and conclusions on the results and potential applicability of the technology.

Additional copies of this report may be obtained at no charge from EPA's Center for Environmental Research Information, 26 West Martin Luther King Drive, Cincinnati, Ohio, 45268, using the EPA document number found on the report's front cover. Once this supply is exhausted, copies can be purchased from the National Technical Information Service, Ravensworth Bldg., Springfield, VA, 22161, (702) 487-4600. Reference copies will be available at EPA libraries in their Hazardous Waste Collection. You can also call the SITE Clearinghouse hotline at 1-800-424-9346 or 382-3000 in Washington, DC, to inquire about the availability of other reports.

Margaret M. Kelly, Acting
Director, Office of Program
Management and Technology

Alfred W. Lindsey, Acting Director,
Office of Environmental Engineering
and Technology Demonstration

ABSTRACT

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SECTION 1

INTRODUCTION

In response to the Superfund Amendments and Reauthorization Act of 1986 (SARA), the Office or Research and Development (ORD) and Office of Solid Waste and Emergency Response (OSWER) have established a formal program to accelerate the development, demonstration, and use of new or innovative technologies. ORD has also established a program to demonstrate and evaluate new innovative measurement and monitoring technologies. These two program areas are called the Superfund Innovative Technology Evaluation, or the SITE Program.

The primary purpose of SITE is to enhance the development and demonstration, and thereby establish the commercial availability, of innovative technologies applicable to Superfund sites.

There are four parts to the SITE Program:

1. To identify and, where possible, remove impediments to the development and commerical use of alternative technologies.
2. To conduct a demonstration program of the more promising innovative technologies to establish reliable performance and cost information for site characterization and cleanup decisionmaking.
3. To develop procedures and policies that encourage selection of available alternative treatment remedies at Superfund sites.
4. To structure a development program that nurtures emerging technologies.

The EPA recognizes that a number of forces inhibit the expanded use of alternative technologies at Superfund sites. The objective of the first part of the program is to identify and evaluate these impediments and remove them or design methods to promote expanded use of alternative technologies.

The second part of the SITE Program is the demonstration and evaluation of selected technologies. This is a significant ongoing effort involving ORD, OSWER, EPA Regions, and the private sector. The objective of the demonstration program is to test and evaluate field-ready technologies. The demonstration program will provide Superfund decisionmakers with the information necessary to evaluate the use of these technologies in future cleanup actions.

A demonstration of the American Combustion, Inc., (ACI) Pyretron Thermal Destruction System has been performed under the SITE program. This system is an innovative combustion system for application to waste incinerators. The system allows the use of oxygen enhancement of the incineration process. For rotary kiln applications, the system consists of rotary kiln and afterburner combustor burners capable of introducing both air and oxygen to the combustion process, a gas (fuel, air, and oxygen) metering and control assembly, and a computer-based control system with proprietary control logic. A prototype Pyretron system was retrofit to the rotary kiln incinerator (RKS) at EPA's Combustion Research Facility for the SITE demonstration. The demonstration program was performed using contaminated soil from the Stringfellow Superfund site. For most tests, the Stringfellow waste was combined with the listed RCRA hazardous waste, K087, decanter tank tar sludge from coking operations. This combined waste was chosen so that the test waste would have signifcant heat and principal organic hazardous constituent (POHC) content and, thereby, present a challenge to the incineration process. The mixed waste consisted of 60 percent (weight) K087 and 40 percent Stringfellow soil. In all tests, the test waste was batch charged to the RKS using a ram feed system which fed waste packed into fiber pack drums.

The demonstration program consisted of emissions testing of a condition challenging the limit of capability of a conventional air-only incineration process in terms of feed mass per charge and total waste feedrate. Results were then compared to similar testing under three modes of Pyretron O_2 enhanced operation:

- The same waste feed schedule and auxiliary fuel flow established in the optimum conventional incineration test
- Increased charge mass at constant total feedrate
- Increased total waste feedrate at constant charge mass

The objective of the demonstration test program was to provide the data to evaluate three ACI claims regarding the Pyretron system:

- The Pyretron system with oxygen enhancement reduces the magnitude of the transient high levels of organic emissions, CO, and soot ("puffs") that occur with repeated batch charging of waste fed to a rotary kiln
- The Pyretron system with oxygen enhancement is capable of achieving the RCRA mandated 99.99 percent destruction and removal efficiency (DRE) of POHCs in wastes incinerated at a higher waste feedrate than conventional, air-only, incineration
- The Pyretron system is more economical than conventional incineration

This report summarizes the results of the demonstration test program.

SECTION 2

EXECUTIVE SUMMARY

The SITE demonstration of the American Combustion Inc. (ACI) Pyretron oxygen-enhanced burner system was conducted during late 1987 through early 1988 at the U.S. Environmental Protection Agency's Combustion Research Facility (CRF) in Jefferson, Arkansas. A prototype Pyretron system was installed on the CRF's rotary kiln incinerator System (RKS). This demonstration was conducted using a mixture of decanter tank tar sludge from coking operations (RCRA listed waste K087) and waste soil excavated from the Stringfellow Superfund site near Riverside, California. These two wastes were mixed together to provide a feed stream that had high levels of organic contamination and in a soil matrix. This was determined to be the best material to use to evaluate the performance of the Pyretron system. The purpose of the demonstration tests was to provide the data to evaluate three ACI claims regarding the Pyretron system noted in Section 1.

Two Pyretron burners were installed on the RKS at the CRF: one in the kiln and one in the afterburner. Valve trains for supplying these burners with controllable flows of auxiliary fuel, oxygen, and air, and a computerized process control system were also provided.

As noted above, waste incinerated during the demonstration was a mixture of 60 percent decanter tank tar sludge from coking operations (RCRA listed waste K087) and 40 percent contaminated soil from the Stringfellow Superfund site. The K087 waste was included in the test mixture to provide high levels of several polynuclear automatic hydrocarbon compounds. Six of these, naphthalene, acenaphthylene, fluorene, phenanthrene, anthracene, and fluoranthene were selected as the POHCs for the test program. The Stringfellow soil was included to make the resulting feedstream more closely resemble the type of waste that might be incinerated using this technology at a Superfund site. Eight tests were performed. These tests were designed to compare oxygen enhanced incineration to air-only incineration using the Pyretron. For all tests the test waste packed into 5.7 L (1.5 gal) fiber pack drums. Drums contained between 4.1 and 7.9 kg (9 and 17 lb) of waste. During each test the feed and effluent streams were sampled and analyzed to determine their levels of POHC and other organic compounds. In addition levels of carbon monoxide, carbon dioxide, oxygen, and total unburned hydrocarbons in the exhaust gas were continuously measured and recorded. Comparison of the stripchart recordings obtained from oxygen enhanced and air only operation would allow for a determination of whether or not the controlled introduction of oxygen reduced transient emissions.

Section 3 of the report provides a description of the Pyretron system and a discussion of ACI's claims for the process. Section 4 describes the characteristics of the test waste materials. Section 5 provides a description of the RKS at the CRF and discusses the incinerator operating conditions for each of the eight tests performed. The effluent stream sampling and analysis procedures employed are described in Section 6. Test results are discussed in Section 7 with emphasis on POHC destruction and removal efficiencies (DRE) achieved, incinerator particulate emissions, and residual discharge stream contamination levels. Test program conclusions are summarized in Section 8. Section 9 discusses test program quality assurance (QA) matters and presents the result of the QA checks performed.

SUMMARY RESULTS

Transient Emissions

Comparison of the CO levels in the kiln exit flue gas indicates that no significant differences in transient emissions between air-only incineration and Pyretron O_2 enhanced operation could be readily observed. Statistical analysis of CO peak height and peak area indicated that test to test variation was greater than the variation observed between air-only and O_2 enhanced operation. As a consequence it was not possible to conclusively determine whether the Pyretron system with O_2 enhancement was able to reduce the magnitude of transient emissions produced when high heating value waste is batch changed to a rotary kiln.

POHC DREs

Incinerator flue gas at the scrubber system exit contained nondetectable levels of all of the test POHCs for all tests performed. Consequently POHC DREs were greater than 99.99 percent for all POHCs for all tests. Pyretron O_2 enhanced operation performance was no different than conventional air-only incinerator performance with respect to POHC DRE.

Particulate Emissions

Particulate levels in the scrubber system discharge flue gas were in the 20 to 40 mg/dscm at 7 percent O_2 range for the three Pyretron O_2 enhanced tests and one conventional air-only test for which they were measured at this location. All levels were significantly below the hazardous waste incinerator performance standard of 180 mg/dscm at 7 percent O_2.

Waste Throughput Increases

The tests showed that the Pyretron system with O_2 enhancement was capable of achieving a 60 percent increase in batch waste charge mass over that possible with conventional air-only incineration at constant total mass feedrate. In addition, the Pyretron system with O_2 enhancement was capable of achieving double the waste throughput possible with conventional incineration. However, this throughput increase necessitated the addition of water to the kiln to control kiln temperature. This water was a required heat sink to compensate for the removed heat sink represented by the nitrogen in the air that the oxygen stream replaced. Transient emissions, POHC DRE performance, particulate emissions, and incineration residuals (kiln ash and scrubber blowdown) quality were comparable under all operating conditions.

Costs

Since the Pyretron sytems is a burner system and, therefore, only one of many components of an incineration system, the use of the Pyretron can be expected to affect waste treatment costs only incrementally. Further, since the capital cost for any burner system is only a fraction of the capital cost for the entire incinerator, the majority of the costs associated with the use of the Pyretron system will be associated with the costs of auxiliary fuel and oxygen.

This demonstration was done at a pilot-scale research facility and not under actual field conditions. Thus, the incremental effect of using the Pyretron system on the cost of incinerating a ton of waste cannot be directly determined. It is likely that the major factor in determining the cost effectiveness of the Pyretron will remain the cost of the oxygen and fuel. These costs vary widely depending upon location and scale of operation.

ACI estimates that it incurred $50,000 in prototype system design and process control algorithm development efforts for the demonstration program. ACI further estimates that the prototype system installed at the CRF cost $150,000. A total of 36,800 sm^3 (1,300 MSCF) of oxygen was consumed during the demonstration test program. Although this oxygen was supplied at no cost, at tpyical oxygen costs of between $0.088 and $0.194/$sm^3$ ($2,50 to $5.50/MSCF), between $3,250 and $4,870 worth of oxygen was consumed. A total of 1,750 GJ (1,670 million Btu) of propane was consumed over the demonstrative test program. At typical propane costs of between $2.84 and $5.70/GJ ($3.00 to $6.00/million Btu), between $5,000 and $10,000 worth of propane was consumed over the test program. About 40 percent of the propane was fired during the Pyretron O_2 enhanced system tests. The remaining 60 percent was fired during conventional air-only testing.

SECTION 3

PROCESS DESCRIPTION AND EXPLANATION OF DEVELOPER'S CLAIMS

The Pyretron Thermal Destruction System designed for application to a rotary kiln incinerator consists of two burners, one installed in the primary combustion chamber (kiln) and one installed in the afterburner; valve trains for supplying these burners with controllable flows of auxiliary fuel, oxygen, and air; a computerized process control system; an oxygen supply system; and a kiln water injection system. A schematic of the system is shown in Figure 1. The Pyretron burners use a parallel combustion approach based upon the independent introduction of two distinct oxidizers to each burner, each of which has significant differences in oxygen content. In most situations, as demonstrated in this test program, one of the two oxidizers will be pure oxygen while the second oxidizer will be air and/or oxygen-enriched air.

The burner is designed to provide a pyrolytic combustion zone where fuel is mixed with pure oxygen under substoichiometric conditions. This pyrolytic zone, which is located inside the flame envelope, is used to provide high flame luminosity and stability. A second combustion stage is established by mixing the hot combustion products of the pyrolytic flame core with the secondary oxidizing gas, typically air or oxygen-enriched air. The secondary oxidizing gas is directed toward the pyrolytic flame core from the area surrounding the core inside a water-cooled burner chamber. The resulting oxidation of the fuel stream from both inside and outside directions results in rapid oxidation and expansion of the combustion products before they leave the burner tunnel, thus providing a high velocity, highly turbulent flame which serves to enhance oxygen mass transfer inside the incineration chambers.

The system uses a programmable logic controller to effect process control. The control system is based upon a process control algorithm that is designed to maintain both process temperature and excess oxygen levels. This control algorithm allows preset responses to process deviations (discussed below) by changing the amount of nitrogen-containing combustion air introduced into the incineration process. Nitrogen occupies a major fraction of a conventional combustion chamber volume and likewise represents a sink for a major fraction of the burner heat input. In the Pyretron system, the amount of nitrogen can be controlled by varying the ratio of the two oxygen sources (air and oxygen), delivered to the burners.

When the combustion system of a conventional kiln and afterburner uses only air to supply combustion oxygen, the only process parameter that can be controlled to maintain the desired operating temperatures is the auxiliary fuel heat input introduced by the burners. When the Pyretron system is utilized, an additional process control parameter exists, namely the percent

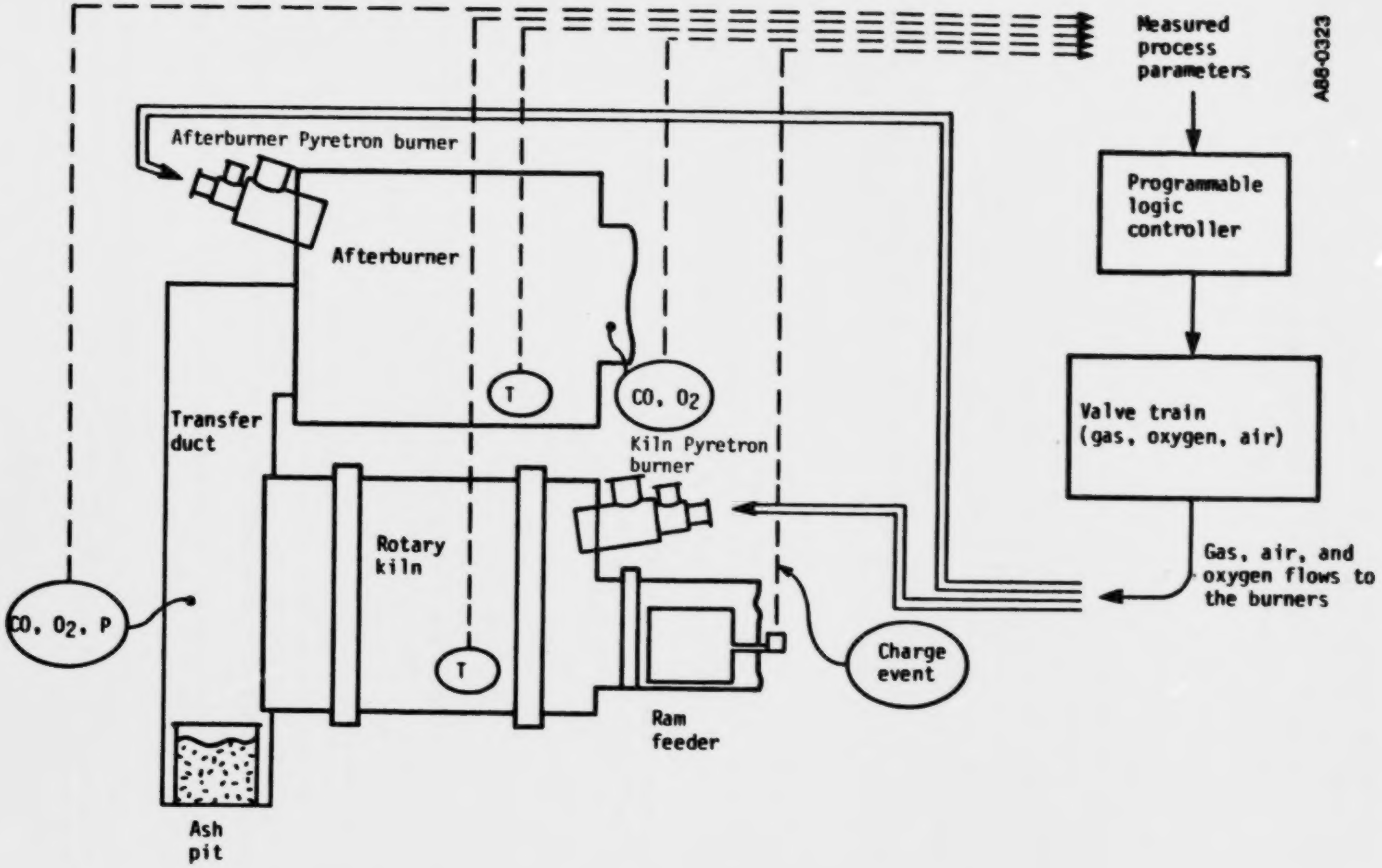
Measured process parameters
A88-0323
Programmable logic controller
Valve train (gas, oxygen, air)
Gas, air, and oxygen flows to the burners
Afterburner Pyretron burner
Afterburner
T
CO, O2
Transfer duct
Kiln Pyretron burner
Rotary kiln
CO, O2, P
T
Charge event
Ram feeder
Ash pit

Figure 1. Pyretron thermal destruction system process diagram.

of oxygen in the combustion air supplied to the burners. With the Pyretron system it is possible to replace 50 percent of the amount of combustion oxygen available for organic contaminant destruction without adding additional diluent nitrogen. Combustion gas temperatures can be maintained with a lower auxiliary fuel heat input because the combustion gas heat sink represented by the additional nitrogen is removed. In addition, combustion gas residence time is increased because the diluent nitrogen is removed from the combustion gas volume.

Dedicated CO and O_2 analyzers are used in addition to stack gas analyzers to supply the computerized control system information on the measured levels of CO and excess oxygen in the exhaust gases from the primary combustion chamber. When the level of CO and/or excess oxygen deviates from a level deemed appropriate for the given composition and feed volume of the waste, the system can initiate a preprogrammed firing schedule in the primary and afterburner chambers to bring the process back to the desired operating conditions through an automatic increase in the oxygen feedrates, with or without a simultaneous reduction in combustion air supply.

In a typical application, the control algorithm increases the flowrate of oxygen to both the kiln and afterburner burners when one of three events occur:

- A batch waste change event with a predetermined and preset (in the algorithm) subsequent time lapse
- Kiln exit CO levels exceed a predetermined and preset level
- Kiln exit O_2 levels decrease below a predetermined and preset level

A baseline oxygen flowrate to each burner is also preset, as in the increased level to which oxygen flow is increased following one of other above events. When one of the above three events occurs, oxygen flowrates are increased from the baseline levels to the preset higher levels and held at these levels for preset period of time. After this time period, oxygen flowrates are returned to baseline levels provided no triggering condition still exists (e.g., sustained high CO or low O_2).

Burner air flowrates are typically controlled to maintain a preset air to auxiliary fuel ratio. Thus, air flowrates increase and decrease with corresponding changes in auxiliary fuel feedrates. Fuel feedrates, in turn, are varied in response to combustor (kiln, afterburner) temperature variations. The control system varies fuel flowrates to maintain combustor temperatures at their setpoints. Preset changes in air flowrates accompanying the oxygen flowrate changes can be incorporated over and above the preset air/fuel ratio if desired. This additional air flowrate control is optional.

ACI proposes that three major advantages will result from application of the system to a rotary kiln incinerator:

- The Pyretron system will be capable of reducing the magnitude of transient high levels of CO, unburned hydrocarbon, and soot ("puffs") that can occur with repeated batch charging of a high heat content waste to a rotary kiln.

- The Pyretron system will allow increased waste feedrate to the kiln while still achieving the hazardous waste incinerator performance standards for POHC destruction and removal efficiency (DRE) and particulate emissions.
- The Pyretron system is more economical than conventional incineration.

The basis for the first claim is as follows. Rotary kiln incinerators are unique in that they are designed to allow at least a portion of the waste load to be introduced or charged to the system in a batch rather than continuous mode. For organic, heating value-containing wastes, a portion of the heat input to the system is correspondingly introduced in a batch mode. Typically, waste containerized in cardboard, plastic, or punctured steel drums is charged to the kiln at established intervals. Upon entry to the kiln, the waste containers are heated until they rupture or burn. This then exposes the waste contents to the hot kiln environment. Volatile organic material then rapidly vaporizes and reacts with available oxygen in the combustion gas. However, if the devolatilization of organic material is more rapid than the rate at which combustion oxygen can be supplied to the kiln, incomplete combustion can result. This can lead to a "puff" of incompletely destroyed organic material exiting the kiln. In most instances, this puff will be destroyed in the system's afterburner. In fact, afterburners are included in rotary kiln incinerator systems for this very reason. However, if the puff is of sufficient magnitude, insufficient excess oxygen and/or residence time may exist in the afterburner to allow its complete destruction.

In conventional incineration systems, the only way to ensure that sufficient oxygen exists in the kiln to allow complete waste oxidation is to increase the air flowrate to the kiln. This can be accomplished either by steadily firing the kiln burner at higher excess air than needed to burn the burner fuel or by increasing the air flowrate in anticipation of or response to a puff. In either instance, an increased air flowrate adds both increased oxygen for waste combustion and increased nitrogen. The increased diluent nitrogen flow is detrimental to complete waste destruction for two reasons. Its presence in the combustion gas volume decreases kiln combustion gas residence time, and, since the nitrogen must be heated, it decreases combustion gas temperature.

In contrast, the Pyretron system offers the capability to increase the amount of oxygen in the combustion process in anticipation of or response to a puff while not adding diluent nitrogen. Thus, kiln temperature can more easily be maintained and additional oxygen needed for waste puff destruction can be introduced with far less an effect on combustion gas volume, hence combustion gas residence time, than possible with air alone. This extra oxygen, without diluent nitrogen, is available for waste puff oxidation. With this additional kiln condition control flexibility, the magnitude of transient puffs should be reduced as compared to similar operating conditions with conventional incineration.

The basis for the second claim, that the Pyretron system will allow increased waste feedrate in a given kiln system, follows from the basis of the first claim. The maximum feedrate of a high organic content waste in a conventional incinerator is determined by the onset of transient puffs which survive the afterburner. When this occurs, waste constituent destruction is less than complete and eventually falls below the regulation mandated 99.99 percent hazardous constituent destruction and removal efficiency.

The discussion supporting the first claim noted that since, the additional oxygen to support waste combustion would be supplied without diluent nitrogen in the Pyretron system, incineration residence times would be greater for a given waste and auxiliary fuel feedrate; therefore, incineration destruction efficiency would be greater. Thus, a feedrate that produced unacceptable transient puffs under conventional incineration would not do so with the Pyretron system. Correspondingly, the onset of unacceptable transient puffs under Pyretron operation would occur at a higher waste feedrate. Thus, acceptable operation at higher waste feedrates (or throughputs) should be possible with the Pyretron system.

The basis for the third claim again follows from the bases for the first two claims. Since the Pyretron system uses oxygen for a portion of the waste oxidant (instead of air), a given set of incineration temperatures can be maintained with less auxiliary fuel feed than is possible with conventional incineration. Less diluent nitrogen is fed, thereby obviating the need to heat this diluent nitrogen to combustion temperature. Thus, auxiliary fuel use per unit of waste treated is less for the Pyretron system than for conventional incineration.

In addition, if higher waste feedrates can be employed in a given combustor with the Pyretron system, then the treatment time required per unit of waste is decreased. This affords further operating cost savings as well as capital recovery cost savings per unit of waste treated.

The test program discussed in this report was specifically designed to evaluate the first two of the above claims and to establish needed data to evaluate the third. The scope of the test program is discussed in Section 5.

SECTION 4

TEST WASTE DESCRIPTION

As noted in Section 1, the demonstration tests were performed using waste material from the Stringfellow Superfund site. For most of the tests performed, the Stringfellow waste was mixed with the listed RCRA hazardous waste K087, decanter tank tar sludge from coking operations. The Stringfellow waste, a contaminated soil containing several hazardous constituent trace metals and few organic constituents at low levels, was chosen for the demonstration because it is the test waste used in past and planned thermal destruction technology evaluations. Specifically, the Stringfellow soil had been tested with the Shirco thermal destruction technology and had been tested in a conventional incineration system. It was decided to use the Stringfellow soil in the Pyretron system demonstration so that data from the Pyretron system demonstration could be compared to those from other test programs.

However, the Stringfellow soil contains very low levels of organic constituents and has negligible heat content. As such, incineration alone would not have permitted an evaluation of the ACI claims discussed in Section 3. Specifically, ACI claims that the Pyretron sytem can reduce the magnitude of "puffs" that can occur with repeated batch charging of a high heat content waste to a rotary kiln and that the Pyretron achieves the hazardous waste incinerator performance standards with increased waste throughput. These claims need to be evaluated with a high-heat-content waste material that has significant concentrations of one or more POHCs.

Since the Stringfellow site waste material has very low organic content and negligible heating value and since a waste material with high heat content and significant POHC concentrations was required to evaluate the Pyretron vendor's claims for the Pyretron process, it was decided to mix the Stringfellow soil with the K087 waste. The resulting mixture used (40 percent Stringfellow soil, 60 percent K087) contained sufficient heating value and percent levels of several POHCs (supplied by the K087).

Characterisics of the Stringfellow soil are summarized in Table 1. These data are from previous characterization analyses of soil excavated from the

TABLE 1. COMPOSITION OF THE STRINGFELLOW SITE CONTAMINATED SOIL FROM LOCATION OA17

Component	Concentration mean (range) (μg/g)
Water, percent	15.8 (9.2 to 28.8)
Total organic carbon	2,150 (1,350 to 2,870)
Sulfate	7,580 (ND to 19,300)
Chloride	103 (9 to 178)
Hazardous organic constituents (Appendix VIII of CFR 261)	
Chloroform	0.18 (ND to 0.85)
Trichloroethylene	0.28 (ND to 1.22)
Tetrachloroethane	0.11 (ND to 0.55)
Chlorobenzene	0.74 (ND to 2.71)
Bis(2-ethylhexyl)phthalate	1.45 (0.65 to 2.08)
DDE	2.94 (0.31 to 8.53)
DDT	15.80 (0.52 to 55.7)
PCB-1260	5.80 (ND to 13.0)
Other organic constituents	
1,4-Chlorobenzene sulfonic acid	1,620 (ND to 4,100)
Ethylbenzene	0.18 (ND to 1.08)
Benzoic acid	0.29 (0.01 to 0.56)
3-Chlorobenzoic acid	1.12 (ND to 4.47)
4-Chlorobenzoic acid	5.09 (ND to 11.0)
4-Chlorobenzoyl chloride	0.59 (ND to 2.36)

ND - Not detected.

TABLE 1. COMPOSITION OF THE STRINGFELLOW SITE CONTAMINATED SOIL FROM LOCATION OA17 (CONCLUDED)

Component	Concentration ($\mu g/g$)		
	Deionized water leach	Strong acid leach	Equivalent EP toxicity limit[a]
Hazardous trace element constituents			
Arsenic	0.89	7.34	100
Barium	0.05	131	20,000
Cadmium	3.03	3.18	20
Chromium	98	912	100
Copper	26.2	135	--
Lead	0.046	97.1	100
Mercury	<0.001	0.044	4
Nickel	7.04	21	--
Zinc	24.7	75.1	--
Other trace elements			
Aluminum	2,470	14,000	--
Calcium	607	11,200	--
Cesium	3.98	46.2	--
Fluorine	127	--	--
Iron	244	21,600	--
Potassium	300	--	--
Lanthanum	1.35	42.6	--
Magnesium	306	5,630	--
Manganese	72.1	267	--
Sodium	523	--	--
Nitrate	37.7	--	--
Titanium	0.24	1,670	--
Uranium	1.25	33.8	--

[a] Since in the EP toxicity procedure, 1 g of material is leached into 20 g of leachate, the value in this column represents 20 times the EP toxicity criterion.

area planned for the tests (1). As noted in Table 1, the contaminated material contains no hazardous organic constituents at levels greater than 100 ppm. In fact, only DDT is present at levels greater than 10 ppm. Low levels of several other organic constituents are noted in Table 1; only 1,4-chlorobenzene sulfonic acid is present at levels above about 1 ppm. This compound is not considered a hazardous organic constituent, however.

Table 1 also notes leachable levels of several hazardous constituents and other trace elements in the Stringfellow material. For the elements with Extraction Procedure (EP) toxicity limits, an equivalent limit corresponding to a solid concentration is also noted. Since the EP toxicity protocol involves leaching of 1 g solid into 20 g of leachate, the equivalent EP limit noted in Table 1 for comparison to the solid concentration noted is 20 times the EP leachate threshold. Based on the data in Table 1, this material would likely be considered EP toxic but only for its chromium content (D007).

As noted above, since the Stringfellow material has very low potential POHC concentrations and since it has very low total organic concentrations or heating value, most of the demonstration tests were performed with a mixture of a high-heating-value waste containing percent quantities of several POHCs, the listed waste K087. Waste characterization data, from a sample analyzed at the CRF in April 1987 are summarized in Table 2. Potential POHC concentrations in this waste as analyzed in the same sample are summarized in Table 3. As indicated, it contains several hazardous polynuclear aromatic hydrocarbon (PAH) components in percent quantities.

The data in Table 3 show that K087 waste concentrations of six PAH constituents are present in the waste at levels above 1.0 percent. These six compounds, naphthalene, acenaphthylene, fluorene, phenanthrene, anthracene and fluoranthene, were designated to be the POHCs in this material.

TABLE 2. CHARACTERIZATION ANALYSES OF THE K087 WASTE

Parameter	Value[a]
Moisture content, %	3.9
Ash, %	5.4
Specific gravity	1.17
Heating value, MJ/kg (Btu/lb)	33.4 (14,380)

TABLE 3. TYPICAL COMPOSITION OF THE K087 WASTE

Component	Concentration (percent by weight as received)
Semivolatile organic hazardous constituents	
Naphthalene	8.3
Acenaphthylene	2.1
Fluorene	1.5
Phenanthrene	3.6
Anthracene	1.4
Fluoranthene	2.3
Benzo(a)anthracene	0.98
Chrysene	0.96
Benzo(a)fluoranthene	0.64
Benzo(k)fluoranthene	0.38
Benzo(a)pyrene	0.70
Indeno(1,2,3-cd)pyrene	0.45
Benzo(g,h,i)perylene	0.45
Other semivolatile organic constituents	
2-Methylnaphthalene	1.0
Dibenzofuran	1.0
4H-cyclopenta[d,e,f] phenanthrene	1.0
Benzo(e)pyrene	1.0
Matter insoluble in methylene chloride	28.6

In the test program performed, the Stringfellow material was test burned alone (K087 not added) for one test using each of the air-only burner operation and the Pyretron system. For these two Stringfellow waste-only tests, the Stringfellow soil waste was spiked with 4,500 ppm each of hexachloroethane and 1,3,5-trichlorobenzene, the POHCs for these tests. In all other tests, the Stringfellow waste was mixed with the K087 material in the ratio of 60 percent (weight) K087 to 40 percent Stringfellow waste. The K087 POHCs noted above were the designated POHCs for these tests.

Test material was packed into 5.7-L (1.5-gal) fiber pack drums for feeding to the rotary kiln via the ram feed system in place. Drums were packed with between 4.1 and 7.7 kg (9 and 17 lb) of the test mixture. Drum weights were recorded on each drum. The fiberpack drums, which are standard containers widely used in the food and pharmaceutical industries, represent pilot-scale versions of fiberpack drums commonly used for feeding waste into industrial rotary kiln incinerators. The specifications and characteristics of these drums are presented in Table 4. The predominant ash residue, sodium silicate, comes from the glue used in the drums.

TABLE 4. FIBERPACK DRUM SPECIFICATIONS

Manufacture:	Continental Fiber Drum, Inc.
Model number:	A0158-2X
Physical dimensions:	20 cm diameter, 16.5 cm tall (8 in diameter, 6.5 in tall)
Maximum capacity:	Volume: 5.7 L (1.5 gal) Weight: 27 kg (60 lb)
Tare weight:	0.45 kg (1 lb) ±5 percent
Construction material:	Base -- Virgin Fourdenier Southern Pine Kraft Paper
Estimated ash content:	13 percent
Certification:	Meets applicable USDA and FDA requirements for containers that come into contact with food and pharmaceutical products. Meets applicable DOT requirements for UFC (rail) and NMFC (truck) packaging.

SECTION 5

TEST FACILITY DESCRIPTION AND INCINERATOR SYSTEM OPERATION

The rotary kiln incinerator system (RKS) at the Combustion Research Facility (CRF) in Jefferson, Arkansas, was used in this test program. A description of the system is presented in Section 5.1 along with discussion of the installed Pyretron system; the test matrix and incinerator operating conditions are described in Section 5.2.

5.1 ROTARY KILN INCINERATOR SYSTEM DESCRIPTION

A simplified schematic of the RKS is given in Figure 2. The system consists of a primary combustion chamber, a transition section, and a fired afterburner chamber. The primary air pollution control system (APCS) consists of a venturi scrubber and a packed-column scrubber. In addition, a backup air pollution control system consisting of a carbon-bed adsorber and a HEPA filter is in place. The primary APCS is typical of those used on actual commercial or industrial incinerators. The backup system is designed to ensure that organic compound and particulate emissions to the atmosphere are negligible. Table 5 summarizes the design characteristics of the main system elements. These are discussed in more detail in the following subsections.

5.1.1 Incinerator Characteristics

The rotary kiln combustion chamber has an inside diameter of 0.95 m (37.5 in.) diameter and is 2.1 m (84 in.) long. The chamber is lined with 13 cm (5 in.) of refractory encased in a 6.3-mm (0.25-in.) thick steel shell. The chamber volume is 1.74 m^3 (61.4 ft^3). Four steel rollers support the kiln barrel. A variable-speed DC motor coupled with a reducing gear transmission tumbles the rotary kiln. Typical rotation speeds range from 0.2 to 1.5 rpm.

The afterburner chamber has a 0.91-m (36-in.) inside diameter and is 2.74 m (9 ft) long. The afterburner chamber wall is constructed of a 15-cm (6-in.) layer of refractory encased in a 6.3-mm (0.25-in.) thick carbon steel shell. The volume of the afterburner chamber is 1.80 m^3 (63.6 ft^3).

As noted in Section 1, a prototype of the ACI Pyretron Thermal Destruction burner system was retrofitted to the RKS for these tests. The system retrofitted consisted of the following: a propane-fired burner installed at the waste feed end of the RKS kiln; a similar burner in the RKS afterburner; gas metering and control assembly (valve trains) for controlling propane, air, and oxygen flows to both burners; an oxygen supply consisting of

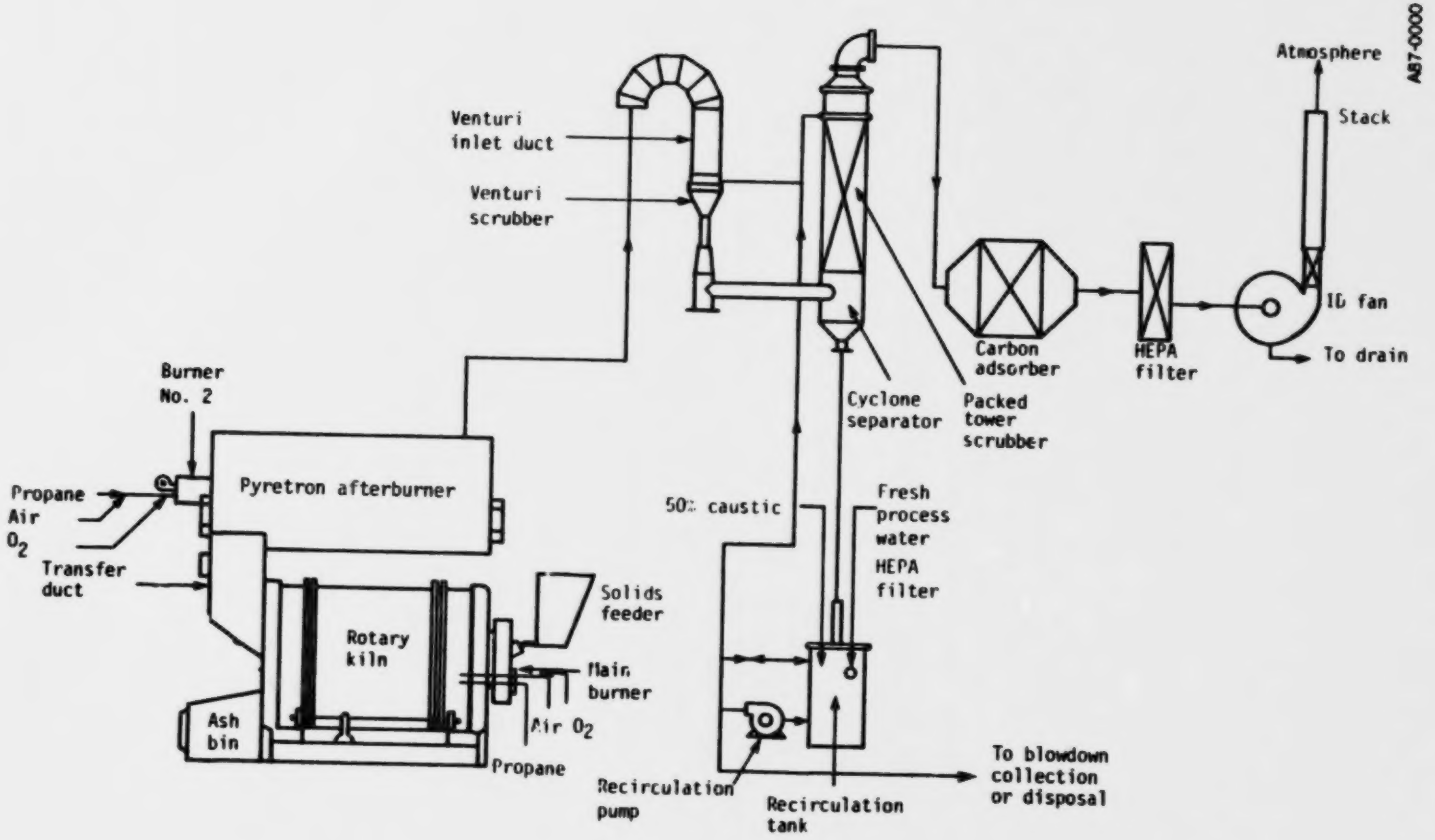
Atmosphere
A87-0000
Stack
Venturi inlet duct
Venturi scrubber
ID fan
To drain
Carbon adsorber
HEPA filter
Burner No. 2
Cyclone separator
Packed tower scrubber
Pyretron afterburner
Propane
Air
O_2
50% caustic
Fresh process water
HEPA filter
Transfer duct
Solids feeder
Rotary kiln
Main burner
Ash bin
Air O_2
Propane
Recirculation pump
Recirculation tank
To blowdown collection or disposal

Figure 2. CRF rotary kiln system.

TABLE 5. DESIGN CHARACTERISTICS OF THE CRF ROTARY KILN SYSTEM

Characteristics of the Kiln Main Chamber	
Length, outside	2.61 m (8 ft 7 in.)
Diameter, outside	1.22 m (4 ft)
Length, inside	2.13 m (7 ft)
Diameter, inside	0.95 m (3 ft 1.5 in.)
Chamber volumn	1.74 m_3 (61.36 ft^3)
Construction	0.63-cm (0.25 in.) thick cold rolled steel
Refractory	12.7-cm (5-in.) thick high alumina castable refractory, variable depth to produce a frustroconical effect for moving solids
Rotation	Clockwise or counterclockwise 0.2 to 1.5 rpm
Solids retention time	1 hr (at 0.2 rpm)
Burner	American Combustion Burner rated at 880 kW (3.0 MMBtu/hr) with dynamic O_2 enchancement capability
Primary fuel	Propane
Feed system	
Liquids	Positive displacement pump via water cooled lance
Sludges	Moyno pump via front face, water-cooled lance
Solids	Metered twin-auger screw feeder or fiberpack ram feeder
Temperature (max)	900°C (1,650°F)
Characteristics of the Afterburner Chamber	
Length, outside	3.05 m (10 ft)
Diameter, outside	1.22 m (4 ft)
Length, inside	2.74 m (9 ft)
Diameter, inside	0.91 m (3 ft)
Chamber volume	1.80 m^3 (63.6 ft^3
Construction	0.63-cm (0.25-in.) thick cold rolled steel
Refractory	15.24-cm (6-in.) thick high alumina castable refractory
Gas residence time	1.2 to 2.5 sec depending on temperature and excess air
Burner	American Combustion Burner rated at 440 kW (1.5 MMBtu/hr) with dynamic O_2 enhancement capability
Primary fuel	Propane
Temperature (max)	1,200°C (2,200°F)
Characteristics of the Air Pollution Control System	
System capacity	
Inlet gas flow	1.7 m^3/min (3,773 acfm) at 1,200°C (2,200°F) and 101 kPa (14.7 psia)
Pressure drop	
Venturi scrubber	7.5 kPa (30 in. WC)
Packed column	1.0 kPa (4 in. WC)
Liquid flow	
Venturi scrubber	77.2 L/min (20.4 gpm) at 69 kPa (10 psig)
Packed column	116 L/min (30.6 gpm) at 69 kPa (10 psig)
pH control	Feed back control by NaOH solution addition

a trailer-mounted liquid oxygen tank with evaporator; and a system for injecting water into the kiln to afford additional kiln temperature control.

The replacement burners were installed on the RKS in the locations noted in Figure 2. These burners were designed to fit directly into the existing refractory penetrations for the existing RKS burners. The gas (propane, air, and O_2) metering and control assembly was fabricated by ACI, shipped to the CRF, and installed just outside the building housing the incinerator. A kiln water injection nozzle was installed in the kiln feed face adjacent to the auxiliary fuel burner. A trailer-mounted O_2 tank with evaporator was supplied by Big Three Industries. The ACI-supplied process control computer system was installed in the CRF control room in parallel with the in place RKS control system. The ACI system controlled the burner flows (propane, air and O_2). The existing RKS control system controlled waste feed and scrubber system operation.

5.1.2 Air Pollution Control Devices

After exiting the afterburner chamber, the combustion gas enters a venturi scrubber which has an automatically adjustable throat. The scrubber is designed to process hot gases at 1,200°C (2,200°F) and operate at 7.5 kPa (30 in. WC) differential pressure. A maximum flow of 77 L/min (20.4 gpm) of dilute NaOH solution enters via the top of the scrubber and contacts the gas to remove acid gases and entrained particulate.

Downstream of the venturi scrubber, the combustion products enter the packed-column scrubber where additional scrubbing occurs. The scrubber column is packed with 5.1-cm (2-in.) diameter polypropylene ballast saddles at a depth of 2.1 m (82 in.). The circulating quench and scrubber liquor is also a dilute aqueous NaOH solution. A pH sensor monitors the scrubber liquor pH, and an integral pH controller that automatically meters the amount of NaOH added to maintain the pH at set point ensures proper HCl removal. For these tests, the scrubber blowdown liquor from the primary APCS flowed directly to a 6,000-gal tanker trailer. At the conclusion of the test program, the collected blowdown water was hauled to an offsite treatment, storage, and disposal facility (TSDF).

At the exit of the packed-column scrubber, a demister removes most of the suspended liquid droplets. In a typical commercial incinerator system, the combustion gases would be vented to the atmosphere at this point. However, a backup APCS is in place at the CRF. The combustion gas passes through a bed of activated carbon designed to adsorb the remaining vapor phase organic compounds. Typically, the carbon bed operates at 77°C (170°F). Because the combustion gas is saturated with moisture and is cooled as it flows through the flue ducts, condensate is continuously formed. The condensate accumulates in the carbon bed and drains via a bottom tap into the blowdown storage tanks. It is then pumped to the tanker truck.

A set of high-efficiency particulate (HEPA) filters designed to remove remaining suspended particulate from the flue gas is located downstream of the carbon adsorption bed. An induced draft fan draws and vents the effluent gas to the atmosphere.

5.2 INCINERATOR SYSTEM OPERATING CONDITIONS

5.2.1 Test Program Overview

The general objective of this test program was to evaluate the Pyretron burner system as an innovative treatment technique for application to various Superfund site wastes. Specific objectives were noted in Section 1. The test program was formulated specifically to address those objectives. The general scope of the test series was as follows:

- Incinerator optimization trials using air-only burner operation with mixed waste (Stringfellow soil with K087) to determine the maximum feed charge mass and total mass feedrate attainable in this mode
- One test at "optimum" operation for mixed waste using air-only burner operation with emissions and residuals sampling
- One test under the "optimum" air-only burner operating conditions of waste feedrate, drum feed frequency, incinerator temperatures, excess air levels, and kiln rotation speed using the Pyretron system with emissions and residuals sampling
- Incinerator optimization trials using the Pyretron system with mixed waste to determine the maximum feed charge mass and total mass feedrate attainable in this mode
- One test under "optimum" air-only burner operating conditions of waste feedrate, incinerator temperatures, excess air levels, and kiln rotation speed using the Pyretron system with emissions and residuals sampling but with drum feed frequency decreased and waste feed mass per charge increased to the maximum attainable in this operating mode
- One test at "optimum" Pyretron system operation for mixed waste (maximum total mass flowrate) with emissions and residuals sampling

In addition, two tests, one using conventional incineration and one using the Pyretron system, feeding Stringfellow soil alone (no K087 added) were performed after completing the demonstration program to supply waste treatability data requested by EPA Region IX.

Emissions sampling during the optimization trials noted above was limited to operation of the flue gas continuous emission monitor (CEM) system described in Section 6. Once a desired test evaluation condition was defined, an emissions and incinerator residuals (kiln ash and scrubber blowdown) sampling and analysis test was performed to evaluate whether the operating condition was in compliance with the hazardous waste incinerator performance standards (POHC DRE and particulate emissions) and to define incineration residuals composition characteristics.

This test series was specifically designed to evaluate two of the three ACI claims put forth regarding the Pyretron system and to develop data to allow evaluation of the third claim. The two claims specifically evaluated were as follows:

- The Pyretron system reduces the magnitude of the transient high levels of organic emissions, CO, and soot ("puffs") that occur with repeated batch charging of waste fed to a rotary kiln

- The Pyretron system is capable of achieving the RCRA-mandated 99.99 percent POHC DRE in wastes incinerated at a higher waste feedrate than that of conventional incineration.

The third ACI claim involving an economic comparison between the Pyretron system and conventional incineration was not specifically evaluated. However, during the test program, air, O_2, auxiliary fuel (propane), and kiln water injection flows were measured. These data will be required in waste treatment cost calculations for both conventional and Pyretron incineration. An evaluation of treatment process economics is presented in the companion Applications Analysis report (2).

To evaluate the two claims specifically addressed required that the capabilities of conventional incineration in incinerating the mixed test waste be established and then show that these capabilities could be surpassed using the Pyretron O_2 enhanced system. Accordingly, the optimization trials under air-only operation focused on establishing the capabilties of conventional incineration. These trials sought to define the conditions of "optimum" conventional incinerator operation. Optimum operation was defined to be the condition that allows the maximum feed charge mass and the maximum total waste mass feedrate achievable under conventional operation with acceptable transients in incinerator flue gas CO and unburned hydrocarbons (puffs). An emissions and incineration residuals (kiln ash and scrubber blowdown) sampling test was performed at this optimum conventional operation condition.

The same incineration conditions of waste feedrate and charge frequency and of incinerator temperatures and excess air levels were next established but with oxygen enhancement via Pyretron operation. An emissions and incineration residuals sampling test was performed for this condition. This effort was not specifically focused on evaluating on ACI claim. Still, it was felt that it may be possible to establish whether or not the Pyretron system gave better performance in terms of POHC DRE and residuals composition than conventional incineration. When compared to the optimum conventional incineration test, the results from this test might support such statements.

Next, optimization trials were performed to define the maximum charge mass possible with the Pyretron O_2 enhanced system but with total waste feed mass feedrate held at the conventional incineration optimum test value. An emissions and residuals sampling test was performed at this increased charge mass condition to evaluate whether compliance with the incinerator performance standards was maintained.

Finally, to establish that the Pyretron system was capable of in-compliance operation at higher waste feedrate than possible under conventional operation required that the maximum waste feedrate possible under acceptable Pyretron O_2 enhanced operation be defined. Optimization trials were performed to define this increased feedrate level. An emissions and residuals sampling test was performed at this "optimum" Pyretron O_2 enhanced operating condition, again to establish that this condition complied with the incinerator performance standards.

In addition to the test program outlined above, tests were also performed with Stringfellow soil alone fed to the kiln. One test was performed under conventional operation, and one test was performed under Pyretron O_2 enhanced operation. These tests were not meant to aid in the evaluation of ACI claims. However, baseline treatability data with Stringfellow waste alone for both operating modes were requested by EPA Region IX for comparison with performance data for other thermal devices mentioned earlier.

The specific tests for which emissions and residuals sampling were performed are listed in Table 6 along with the target test operating conditions specified in the test plan. As noted, the base condition target kiln temperature was 980°C (1,800°F), and target afterburner temperature was 1,120°C (2,050°F). Duplicate emissions testing at two operating conditions was performed during the test program in an attempt to establish the degree of data variability for tests at comparable operating conditions. The replicate tests were performed for optimum air-only and the optimum O_2-enhanced tests. Tests 1 and 2, and 5 and 6 represent these respective replicate tests in Table 6.

Table 7 summarizes the actual average test operating conditions achieved for each of the tests performed. Specific discussion of the incinerator system operation for each test is given in Section 5.2.2 below. Appendix A contains tabulations of incinerator process operating data recorded at 15 min intervals over each test.

Table 8 summarizes the operating conditions for the venturi scrubber/packed-tower scrubber air pollution control system on the RKS. As shown, all tests were performed under roughly comparable APCS operation. Average venturi scrubber liquor flow was 60 to 64 L/min (16 to 17 gpm) with pressure drop of 5.0 to 7.5 kPa (20 to 30 in. WC). Average packed column scrubber liquor flow was 98 to 114 L/min (26 to 30 gpm) with pressure drop of 1.0 to 3.7 kPa (4 to 15 in. WC). Scrubber liquor temperature was generally about 70°C (160°F) with pH between 7.1 and 7.5. Scrubber blowdown rate was 1.9 to 3.8 L/min (0.5 to 1.0 gpm).

5.2.2 Individual Test Incinerator Operating Conditions

The chronological progression of the test program was as follows. Shakedown and optimization tests under conventional (air-only) operation proceeded during late November and early December 1987. As a result of these tests, it was felt that the waste feed schedule which represented the maximum that could be handled with the K087/Stringfellow waste mixture under conventional operation was a feed of 10.9 kg (24 lb) every 10 min or 65.6 kg/hr (144 lb/hr). It was decided to attempt test point 1 (optimum conventional incineration) at this feedrate on December 8, 1987. Figure 3 shows the waste feed schedule for this attempted test. Figure 4 shows traces of propane and air input flowrates, exit temperatures, and exit flue gas O_2 and CO levels for the kiln and the afterburner for this attempted test.

Figure 4 shows that early in the test period, kiln exit temperature varied from about 870° to 980°C (1,600° to 1,800°F) over a charge cycle. Kiln exit O_2 ranged from about 7 to 16 percent O_2 over a cycle, and kiln exit CO

TABLE 6. TARGET TEST PROGRAM SUMMARY

Test no.	Test waste	Burner mode	Test condition	Waste feedrate kg/h (lb/h)	Kiln exit		Afterburner exit	
					Temperature °C (°F)	Nominal O_2 (%)	Temperature °C (°F)	Nominal O_2 (%)
1, 2	Stringfellow soil + K087	Air-only	Optimum waste + K087, air-only	a	980 (1,800)	9	1,120 (2,050)	12
3	Stringfellow soil + K087	O_2 enhanced	Optimum air-only waste + K087 conditions	Same as 3	980 (1,800)	9	1,120 (2,050)	12
4	Stringfellow soil + K087	O_2 enhanced	Optimum air-only waste + K087 feedrate, maximum feed mass per charge	Same as 3, increased charge mass	980 (1,800)	9	1,120 (2,050)	12
5, 6	Stringfellow soil + K087	O_2 enhanced	Optimum waste + K087	a	980 (1,800)	9	1,120 (2,050)	12
7	Stringfellow soil	O_2 enhanced	Spiked waste[b]	55 (120)	980 (1,800)	9	1,120 (2,050)	12
8	Stringfellow soil	Air-only	Spiked waste[b] air-only	55 (120)	980 (1,800)	9	1,120 (2,050)	12

[a] As determined from optimization trials.

[b] Spiked with hexachloroethane and 1,3,5-Trichlorobenzene.

TABLE 7. AVERAGE INCINERATOR OPERATING CONDITIONS

		Waste			Kiln exit		Afterburner exit		
Test no. (date)	Operating mode	Feedrate, kg/h (lb/h)	Charge weight, kg (lb)	Charge interval, min	Temperature, °C (°F)	Flue gas O_2, %	Temperature, °C (°F)	Flue gas O_2, %	Kiln rotation speed, rpm
-- (12-8-87)	Conventional optimization trial	65.5 (144)	10.9 (24)	10	1,027 (1,880)	9.9	1,121 (2,050)	6.4	0.2
1 (12-9-87)	Conventional optimum replicate	47.7 (105)	9.5 (21)	12	954 (1,750)	13.3	1,121 (2,050)	7.7	0.2
2 (12-11-87)	Conventional optimum	47.7 (105)	9.5 (21)	12	921 (1,690)	12.8	1,121 (2,050)	7.4	0.2
3 (12-17-87)	O_2 enhanced at conventional optimum	47.7 (105)	9.5 (21)	12	1,035 (1,895)	17.6	1,121 (2,050)	15.2	0.2
4 (1-14-88)	O_2 enhanced, increased charge mass	47.7 (105)	15.5 (34)	19.5	963 (1,765)	14.5	1,121 (2,050)	15.0	0.2
5 (1-20-88)	O_2 enhanced optimum	95.5 (210)	9.5 (21)	6	979 (1,795)	13.9	1,121 (2,050)	14.0	0.2
6 (1-21-88)	O_2 enhanced optimum replicate	95.5 (210)	9.5 (21)	6	979 (1,795)	14.6	1,121 (2,050)	15.3	0.2
7 (1-27-88)	O_2 enhanced, Stringfellow soil alone	54.5 (120)	3.6 (8)	4	1,010 (1,850)	13.5	1,121 (2,050)	13.5	0.2
8 (1-29-88)	Conventional, Stringfellow soil alone	54.5 (120)	3.6 (8)	4	1,010 (1,850)	8.8	1,121 (2,050)	11.4	0.2

TABLE 8. AVERAGE AIR POLLUTION CONTROL SYSTEM OPERATING CONDITIONS

		Venturi scrubber		Packed column scrubber		Scrubber liquor			
Test no. (date)	Operating mode	Liquor flowrate, L/min (gpm)	Pressure drop, kPa (in. WC)	Liquor flowrate, L/min (gpm)	Pressure drop, kPa (in. WC)	Temperature, °C (°F)	pH	Makeup water flowrate, L/min (gpm)	Blowdown flowrate, L/min (gpm)
-- (12-8-87)	Conventional optimization trial	64 (17)	6.2 (25)	110 (29)	3.7 (15)	--[a]	7.6	17 (4.5)	1.9 (0.5)
1 (12-9-87)	Conventional optimum replicate	64 (17)	5.2 (21)	106 (28)	3.7 (15)	--	7.4	18 (4.7)	3.8 (1.0)
2 (12-11-87)	Conventional optimum	61 (16)	5.2 (21)	110 (29)	3.7 (15)	--	7.5	17 (4.5)	2.6 (0.7)
3 (12-17-87)	O_2 enhanced at conventional optimum	61 (16)	7.5 (30)	114 (30)	2.5 (10)	--	7.5	13 (3.4)	3.8 (1.0)
4 (1-14-88)	O_2 enhanced, increased charge mass	64 (17)	6.2 (25)	114 (30)	1.5 (6)	73 (163)	7.2	15 (4.0)	2.3 (0.6)
5 (1-20-88)	O_2 enhanced optimum	61 (16)	6.2 (25)	98 (26)	1.7 (7)	70 (158)	7.1	16 (4.3)	2.6 (0.7)
6 (1-21-88)	O_2 enhanced optimum replicate	61 (16)	6.0 (24)	98 (26)	1.5 (6)	73 (164)	7.2	16 (4.2)	2.6 (0.7)
7 (1-27-88)	O_2 enhanced, Stringfellow soil alone	64 (17)	6.0 (24)	98 (26)	1.0 (4)	69 (156)	7.3	14 (3.8)	2.6 (0.7)
8 (1-29-88)	Conventional, Stringfellow soil alone	64 (17)	7.5 (30)	98 (26)	1.7 (7)	71 (159)	7.2	9 (2.5)	1.9 (0.5)

[a] -- = Thermocouple not operating.

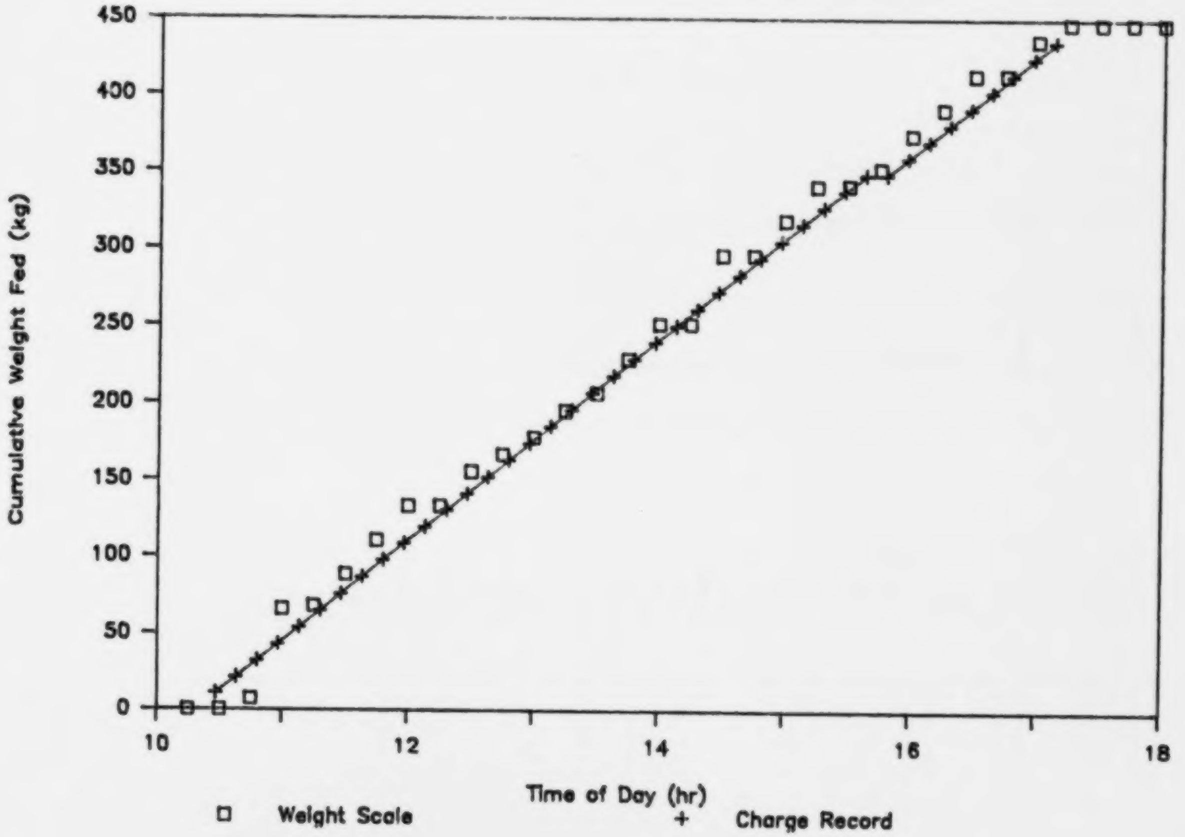

Figure 3. Waste feed schedule for the conventional incineration optimization trial.

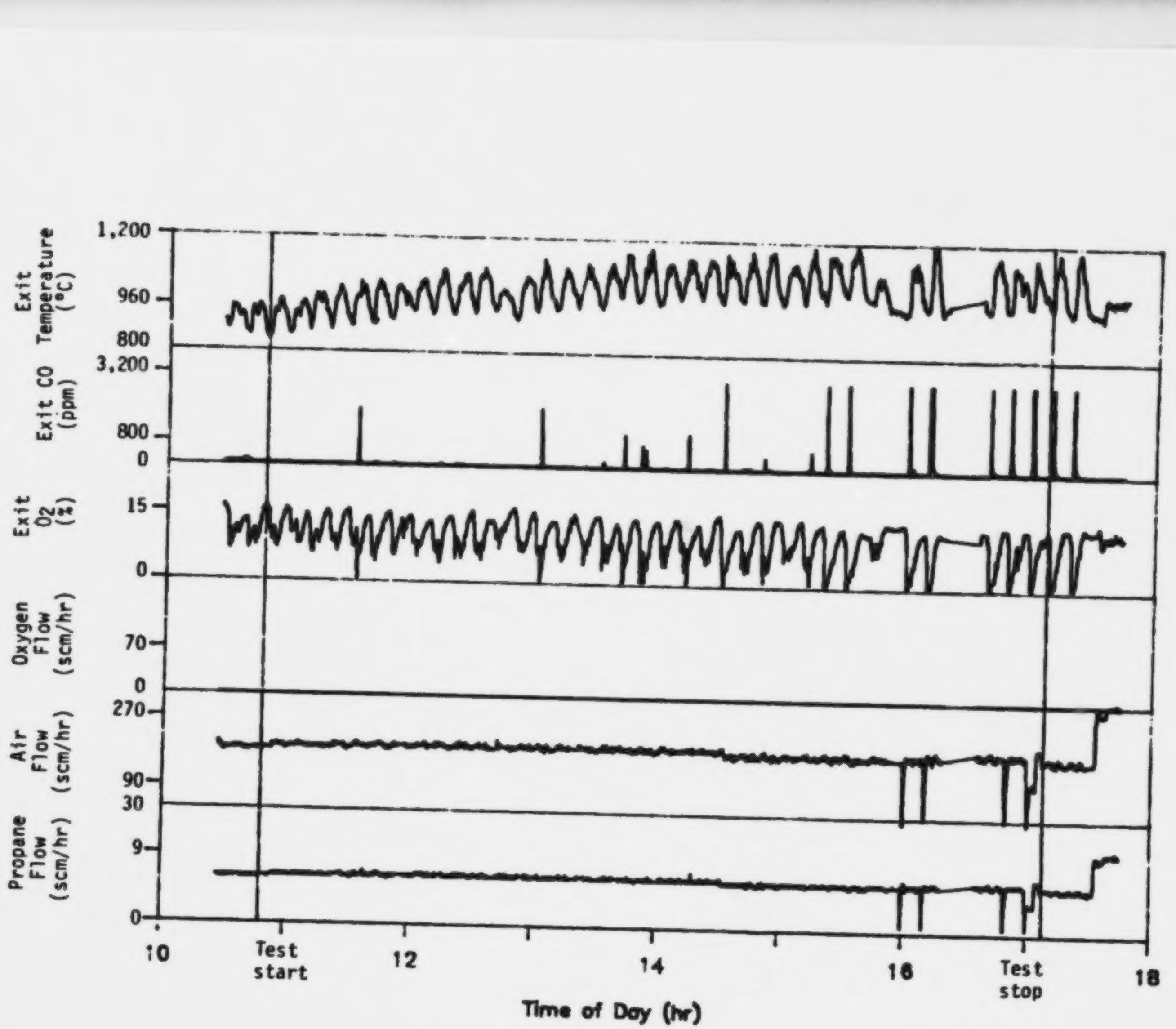

Figure 4a. Kiln data for the conventional incineration optimization trial.

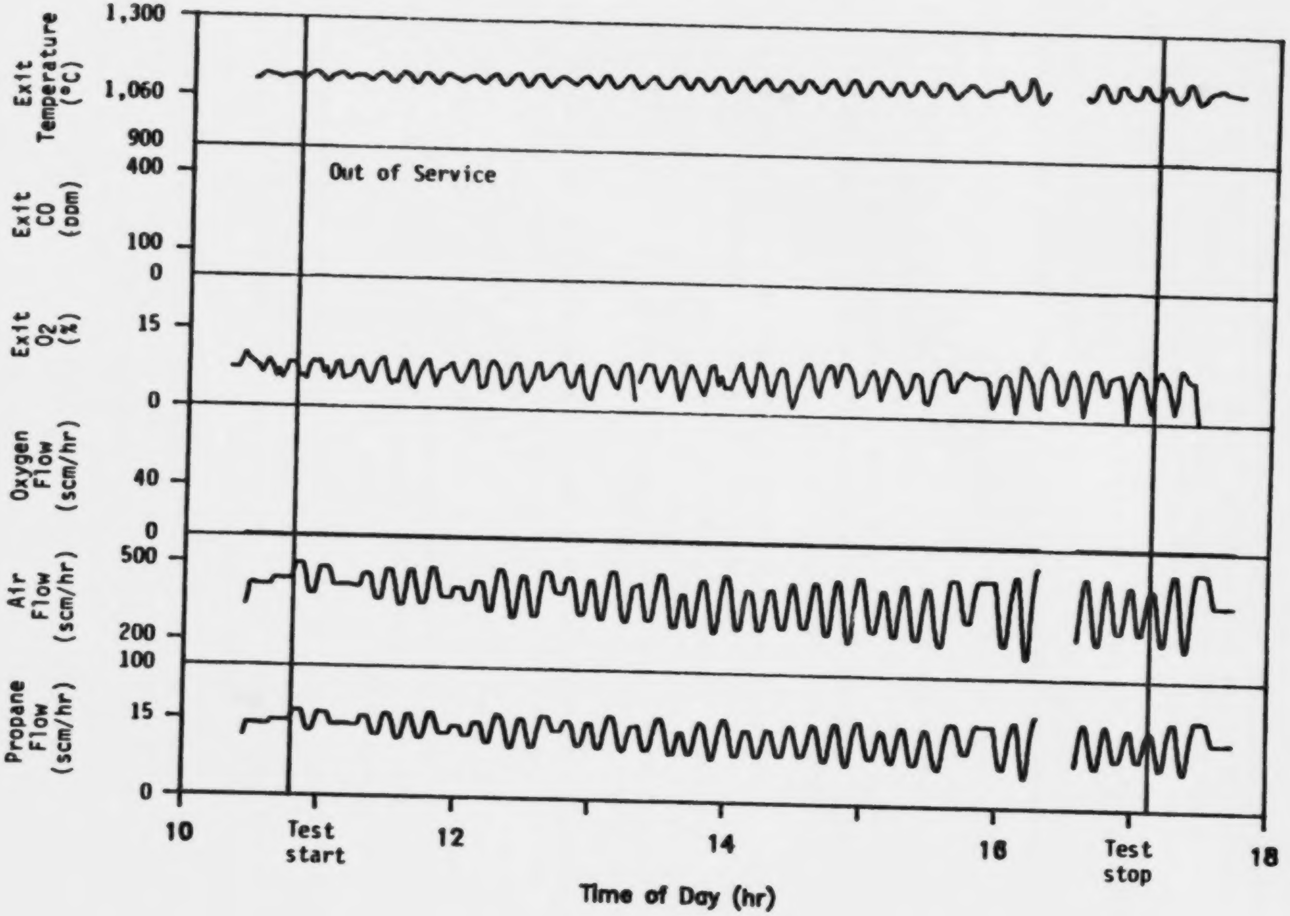

Figure 4b. Afterburner data for the conventional incineration optimization trial.

levels were generally low. However, intermittent CO spikes up to 2,200 ppm occurred. As the attempted test proceeded, kiln temperature increased such that after about 3 hrs of operation, kiln exit temperature was ranging from 980° to 1,150°C (1,800° to over 2,100°F) over a charge cycle. Kiln exit flue gas O_2 peaked at about 15 percent just prior to the start of a batch charge but decreased to 0 as the puff of volatilized waste from a charge filled the kiln. This occurred with each charge late in the attempted test. Kiln exit CO levels peaked at about 3,000 ppm under these depleted O_2 conditions. Figure 5 shows that the CO puffs survived through the afterburner and resulted in CO peaks of above 100 ppm at the stack.

It was decided that this attemped test was indeed beyond the limits of acceptable conventional incinerator operation, and sampling was aborted.

The next attempt to achieve desired condition 1 (optimum conventional incineration) was performed with both charge mass and frequency reduced. This test, which was performed on December 9, 1987, had a feed schedule of 9.5 kg (21 lb) charges every 12 min, or 47.7 kg/hr (105 lb/hr). The waste feed schedule for this test is shown in Figure 6. Corresponding kiln and afterburner data (propane and air flows, exit temperature, and exit flue gas O_2 and CO) are shown in Figure 7.

Figure 7 shows that kiln operating conditions were much more controlled for this test. At stabilized operation, kiln exit temperature ranged from about 900° to 1,080°C (1,650° to 1,970°F) over a charge cycle. Kiln exit CO peaks were less than about 50 ppm, with the exception of one spike early in the test. These were reduced to less than 10 ppm at the stack after passage through the afterburner (see Figure 8).

Unacceptable incinerator operation was experienced on December 8 when 10.9-kg (24-lb) charges were fed every 10 min. In contrast, acceptable operation was achieved when 9.5-kg (21-lb) charges were fed every 12 minutes. Given these results, it was decided to define the 9.5-kg/12-min charge schedule to be at (or at least very near) the limit of capability of conventional incineration with the test waste. This, then, would be the "optimal" conventional incineration operating condition against which the ACI claims would be evaluated.

An abbreviated sampling effort consistent with the planned replicate testing of the optimum conventional incineration operating condition (see Section 6) was completed. This test (Test 1) was designated the replicate optimum conventional incineration test.

This test condition was repeated on December 11, and was designated the optimum conventional incineration test. For this test the feed, incineration residuals, and the flue gas at two locations were sampled and extensively analyzed (see Section 6). Figure 9 shows the waste feed schedule for this test (Test 2). Figure 10 shows corresponding kiln and afterburner operating data.

Figure 10 shows that Test 3 was completed at slightly lower kiln temperature, which ranged from about 870° to 1,040°C (1,600° to 1,900°F) over

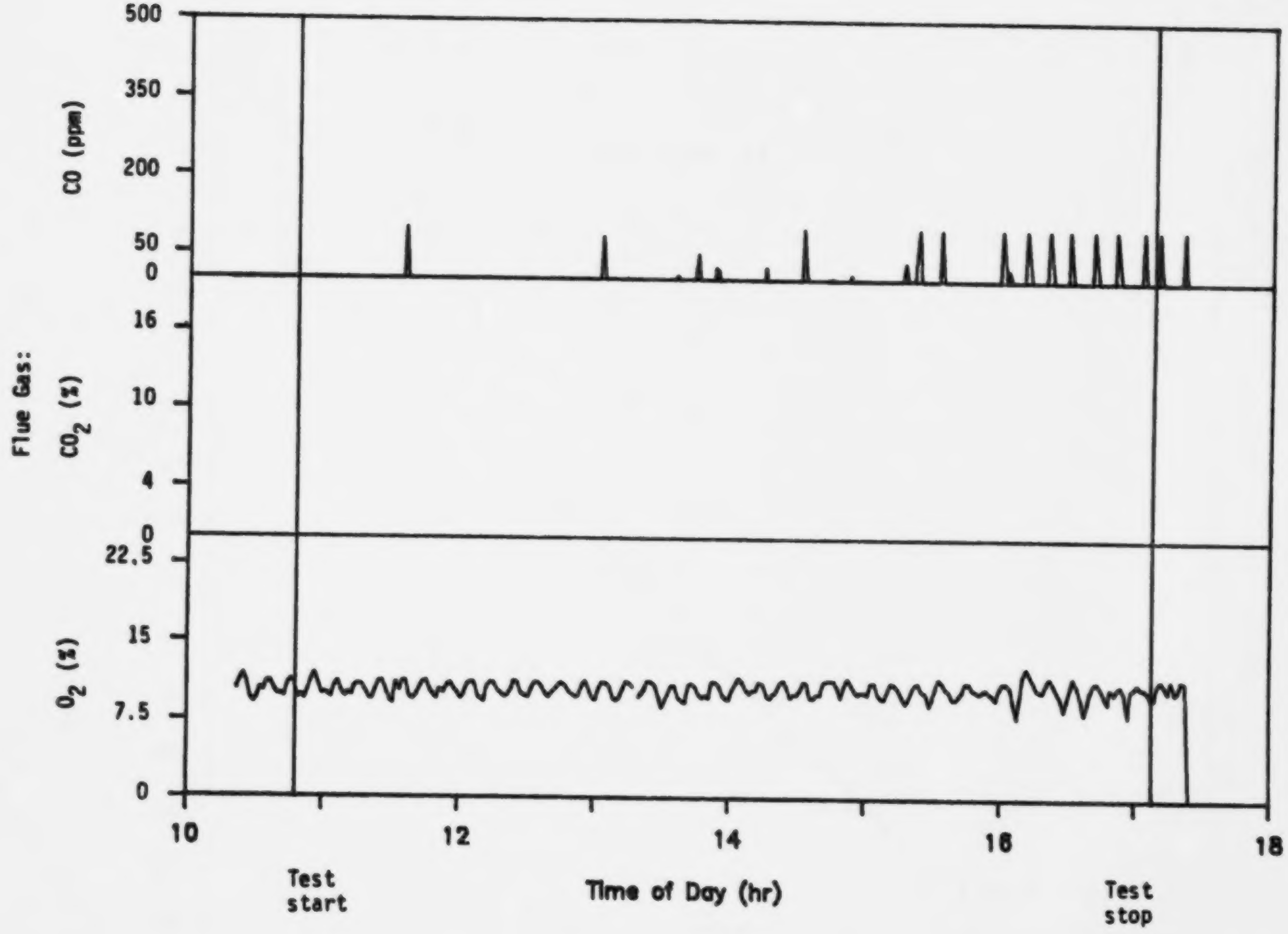

Figure 5. Stack emission monitor data for the conventional incineration optimization trial.

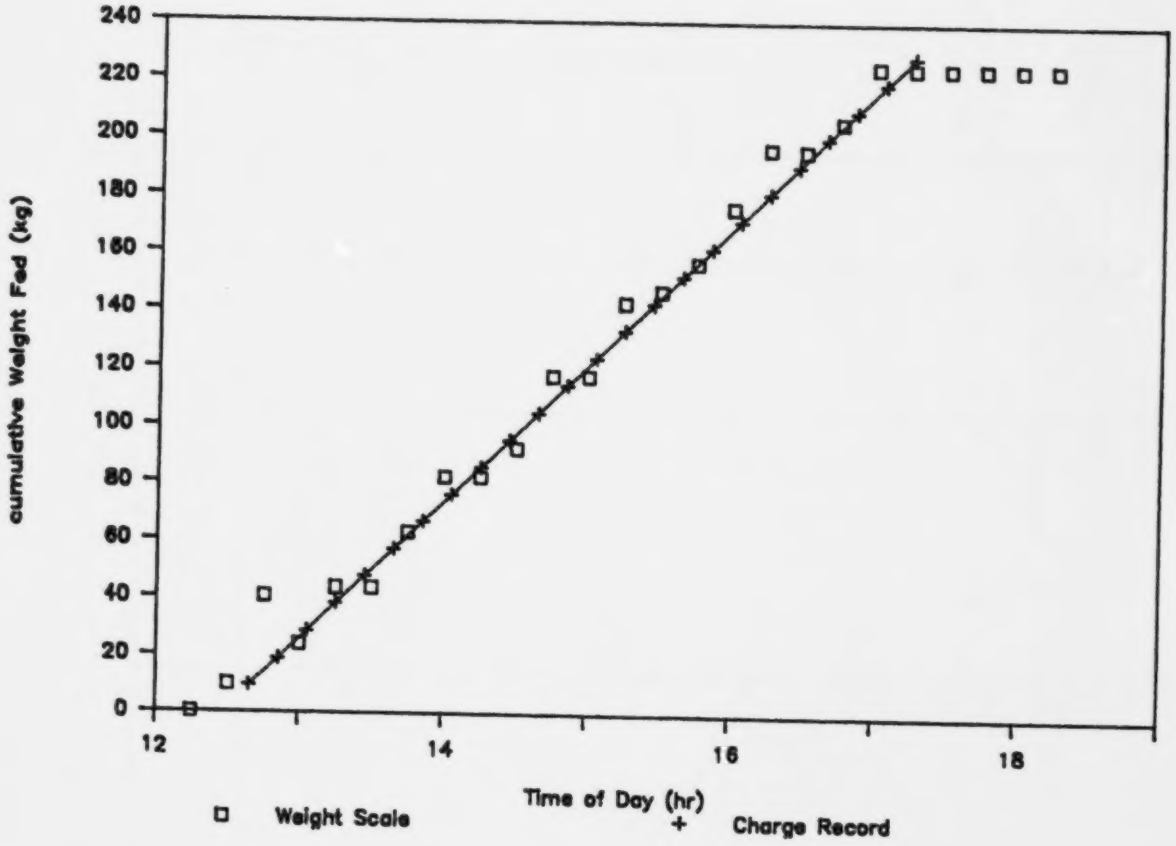

Figure 6. Waste feed schedule for Test 1.

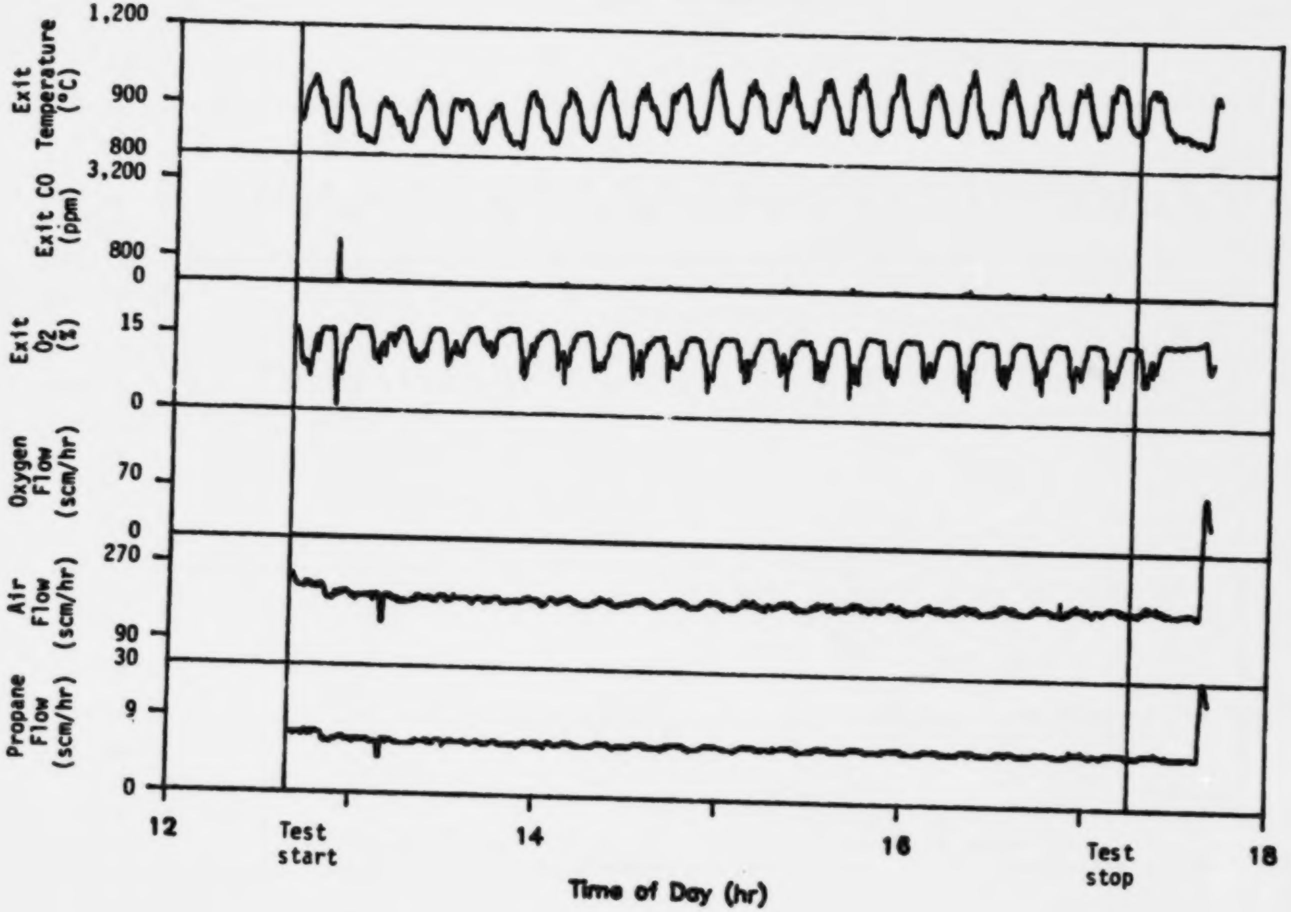

Figure 7a. Kiln data for Test 1.

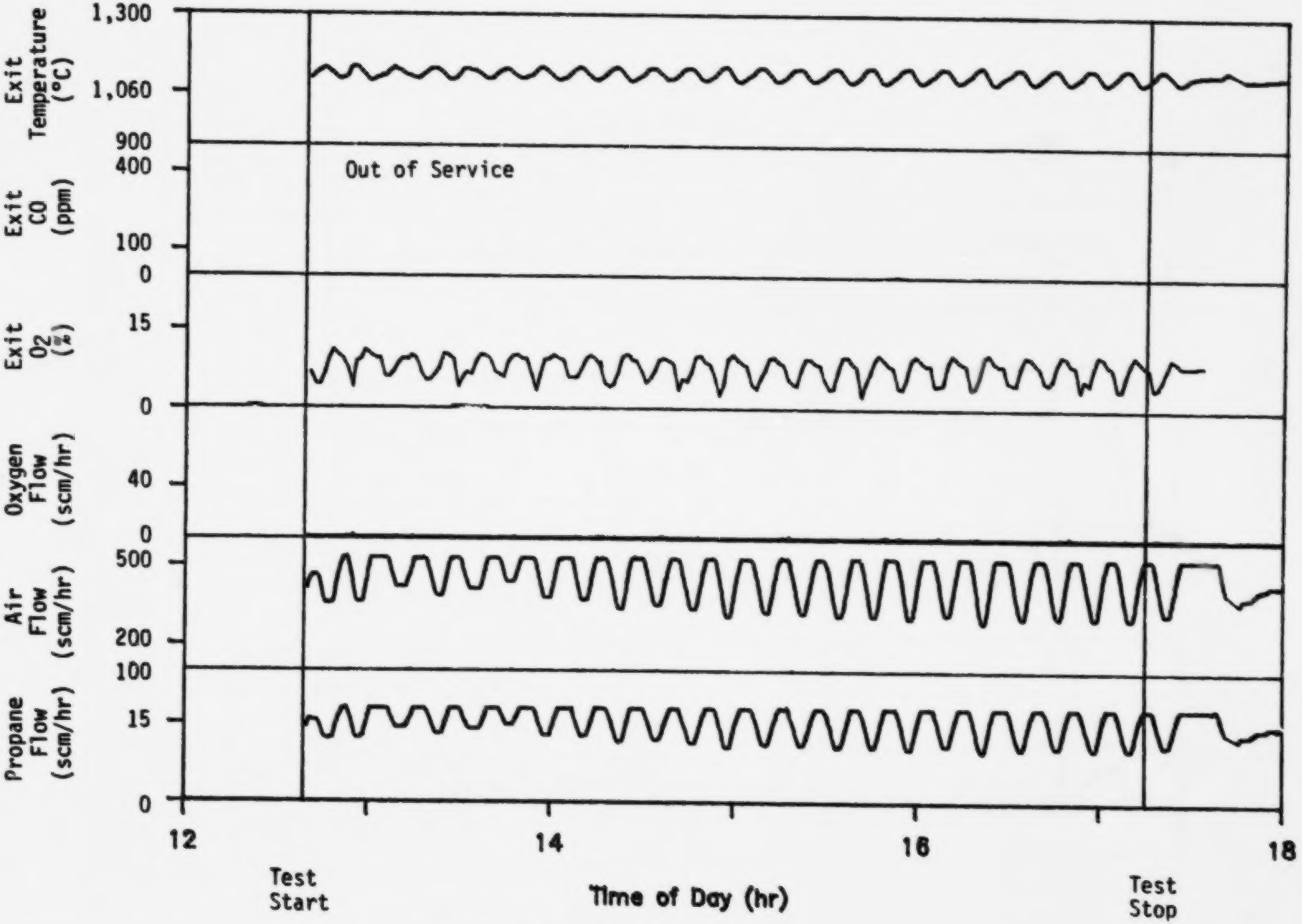

Figure 7b. Afterburner data for Test 1.

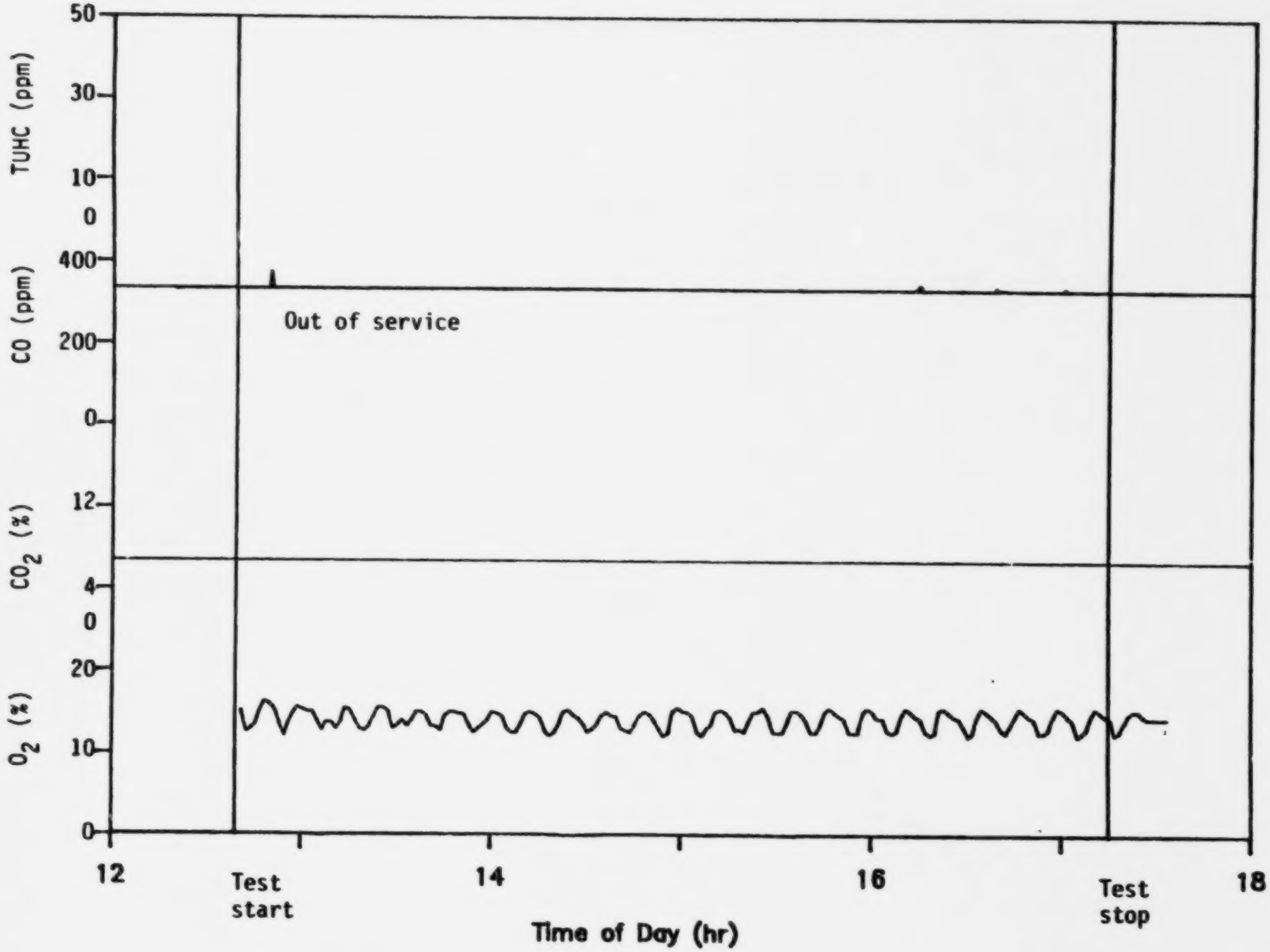

Figure 8. Stack emissions monitor data for Test 1.

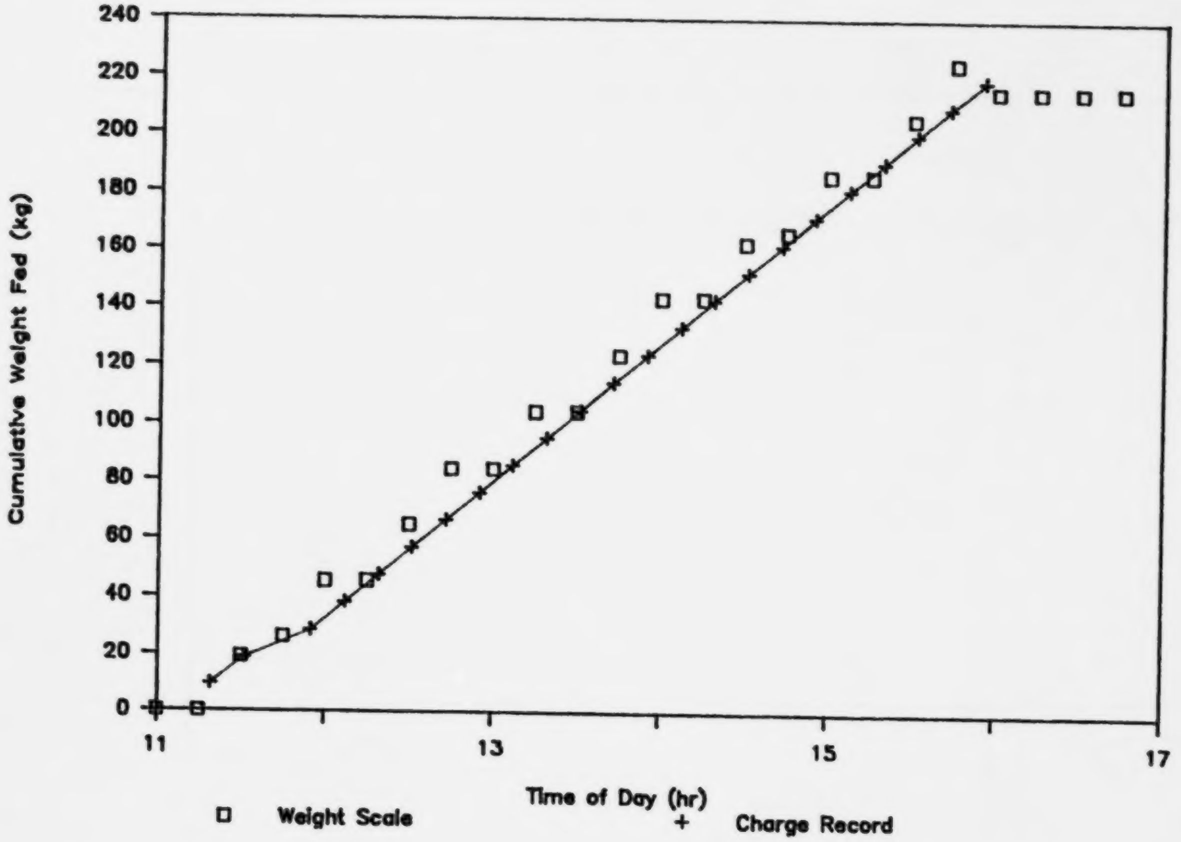

Figure 9. Waste feed schedule for Test 2.

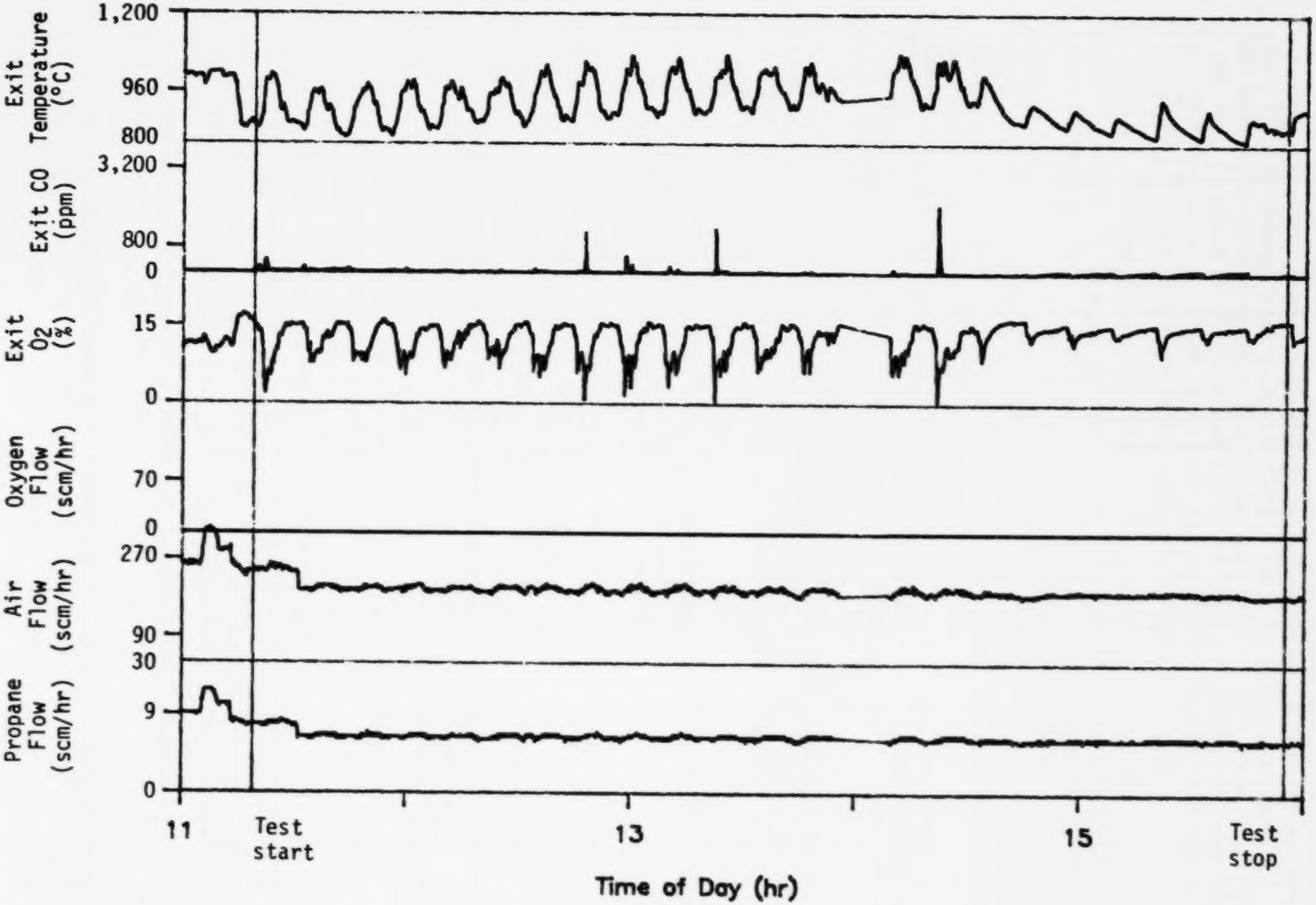

Figure 10a. Kiln data for Test 2.

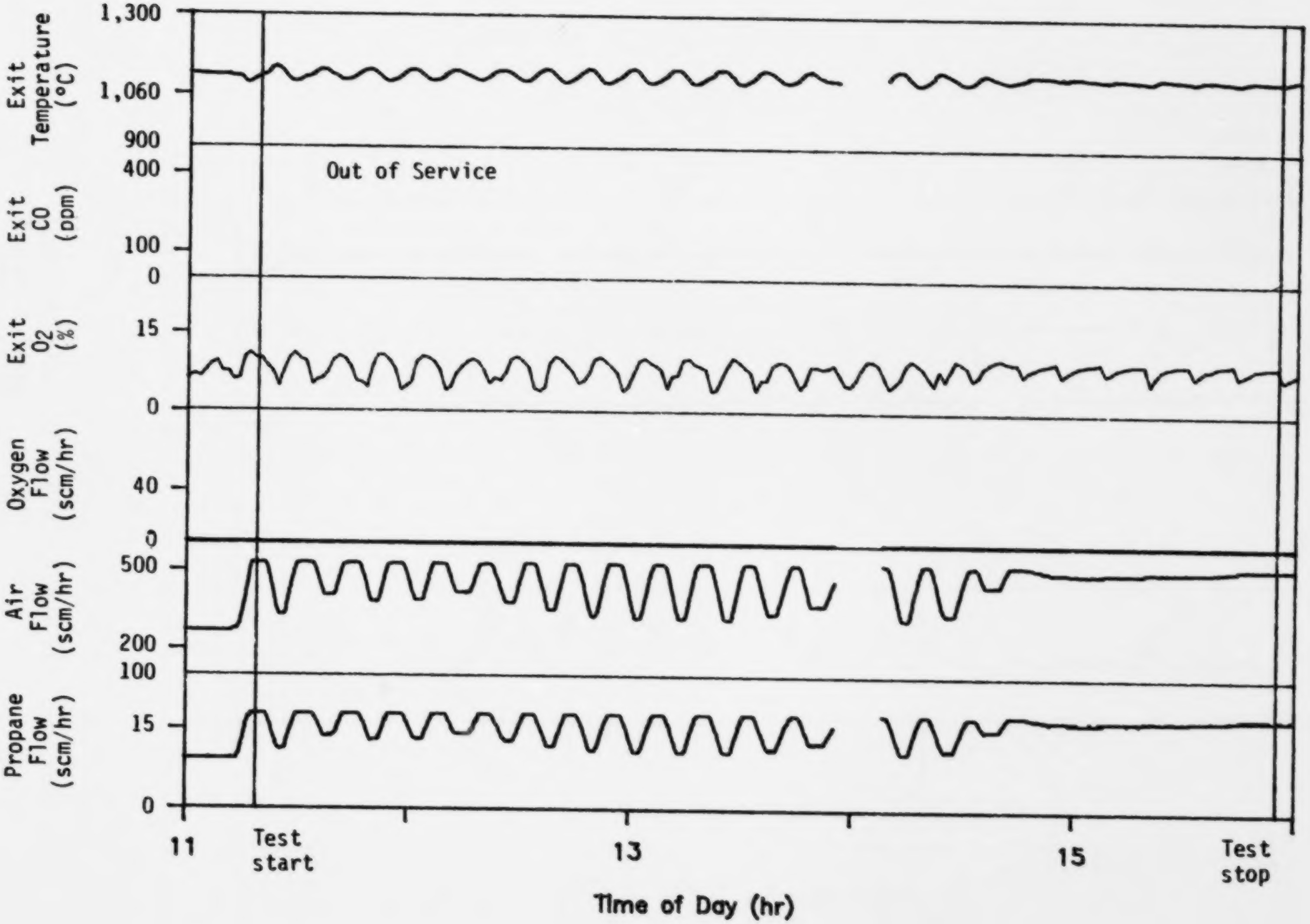

Figure 10b. Afterburner data for Test 2.

a charge cycle. Kiln exit flue gas O_2 was comparable, nominally ranging from about 6 to 15 percent over a charge cycle. On a few occasions when a particularly high-heat-content charge was fed, kiln exit O_2 dropped to below 1 percent; CO peaks up to 2,400 ppm at the kiln exit accompanied these low O_2 occurrences. However, these peaks were easily handled in the afterburner such that 50 ppm or lower stack CO peaks resulted as shown in Figure 11.

Test condition 3 was completed on December 17, 1987. In this test, the operating conditions (waste charge mass and charge frequency and incineration temperatures) of Tests 1 and 2 were replicated using the Pyretron system with oxygen enhancement. The Pyretron O_2 enhanced operating mode was as follows. Experience gained during shakedown testing showed that about 30 seconds after a batch charge to the kiln, the fiberpack drums ignited and discharged their waste contents. Rapid devolatilization and combustion of the more volatile constituents of the waste then occurred, filling the kiln with the waste combustion flame. Burnout of the remaining waste continued over about a subsequent 5-min period. Thus, the period of peak oxygen demand for waste combustion was this 5-min period that started about 30 seconds after the batch charge event.

As noted in Section 3, the Pyretron process control algorithm for O_2 enhanced operation boosts the oxygen flows to the kiln and afterburner burners from a preset baseline level to a preset increased level when one of three triggering events occurs:

- A batch waste charge event followed by a predetermined time lapse
- Excessive CO in the kiln exit flue gas
- Insufficient O_2 in the kiln exit flue gas

The baseline oxygen flowrates were set so that both kiln exit and afterburner exit flue gas O_2 levels were about 15 percent with auxiliary fuel combustion alone. Triggering kiln exit CO and O_2 set points were defined by ACI and entered into the process controller. For the waste charge event trigger, a lag time (after charge) of about 30 seconds was defined. Thus, about 30 seconds after each charge event the oxygen flowrates to the burners were ramped up to an increased level. This increased level was set at that required to prevent flue gas O_2 level from falling significantly below about 15 percent in either the kiln exit or the afterburner exit. Oxygen flowrates were maintained at the preset increased level for about 5 min, then ramped down to the baseline level, provided the kiln exit CO was below and O_2 was above respective trigger levels. Auxiliary fuel flowrates were controlled to maintain respective combustion chamber temperatures.

Burner air flowrates varied directly with fuel flowrate according to the set air/fuel ratio. No decrease in burner air flowrates were set to accompany increased oxygen flowrate. This increase in the oxygen available for combustion in anticipation of peak waste O_2 demand (30 seconds after each batch charge) was the basis for reducing the magnitude, or preventing the occurrence, of transient "puffs."

Figure 12 shows the waste feed schedule for Test 3. Figure 13 shows corresponding kiln and afterburner data for this test. Oxygen feed flows to

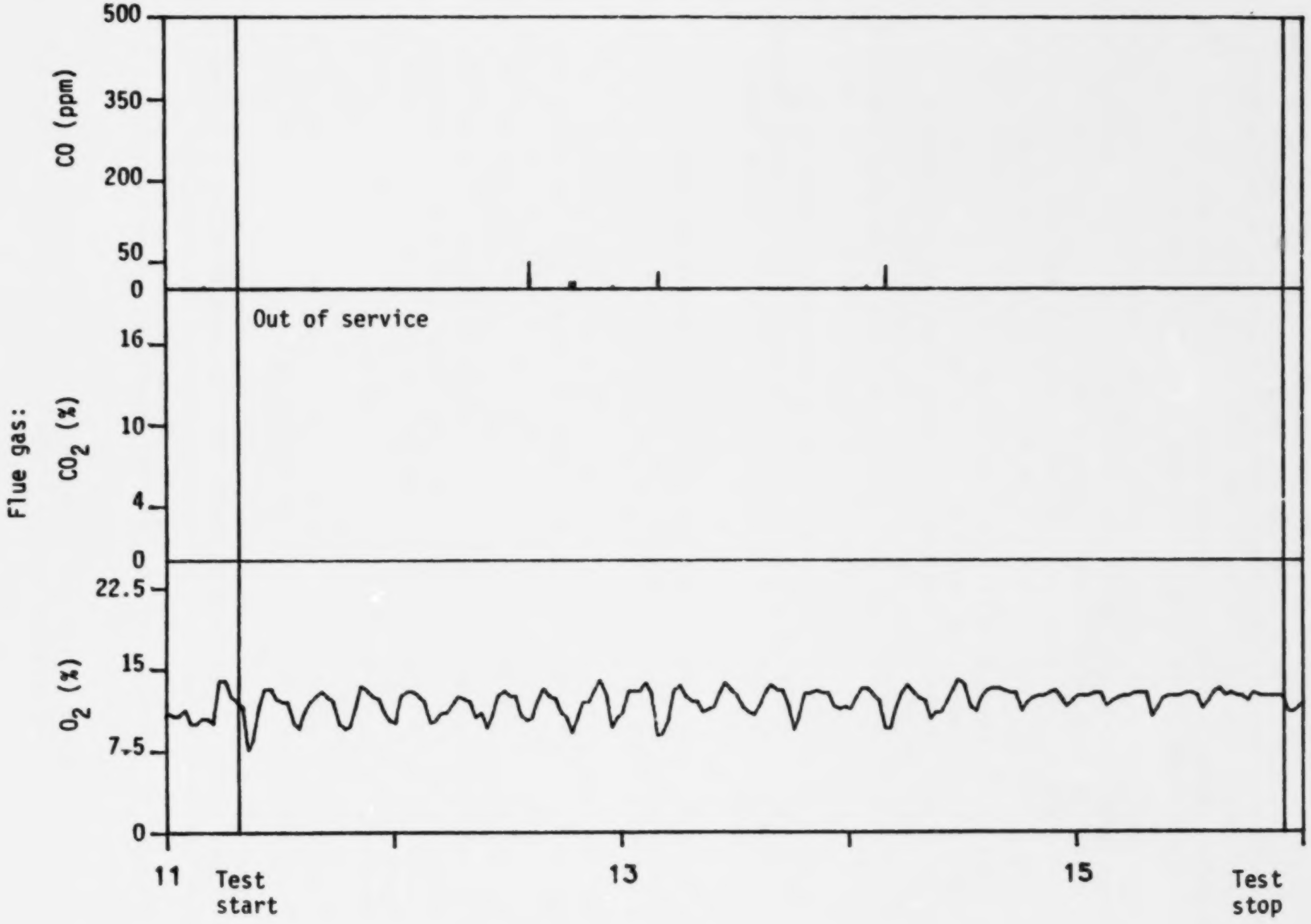

Figure 11. Stack emissions monitor data for Test 2

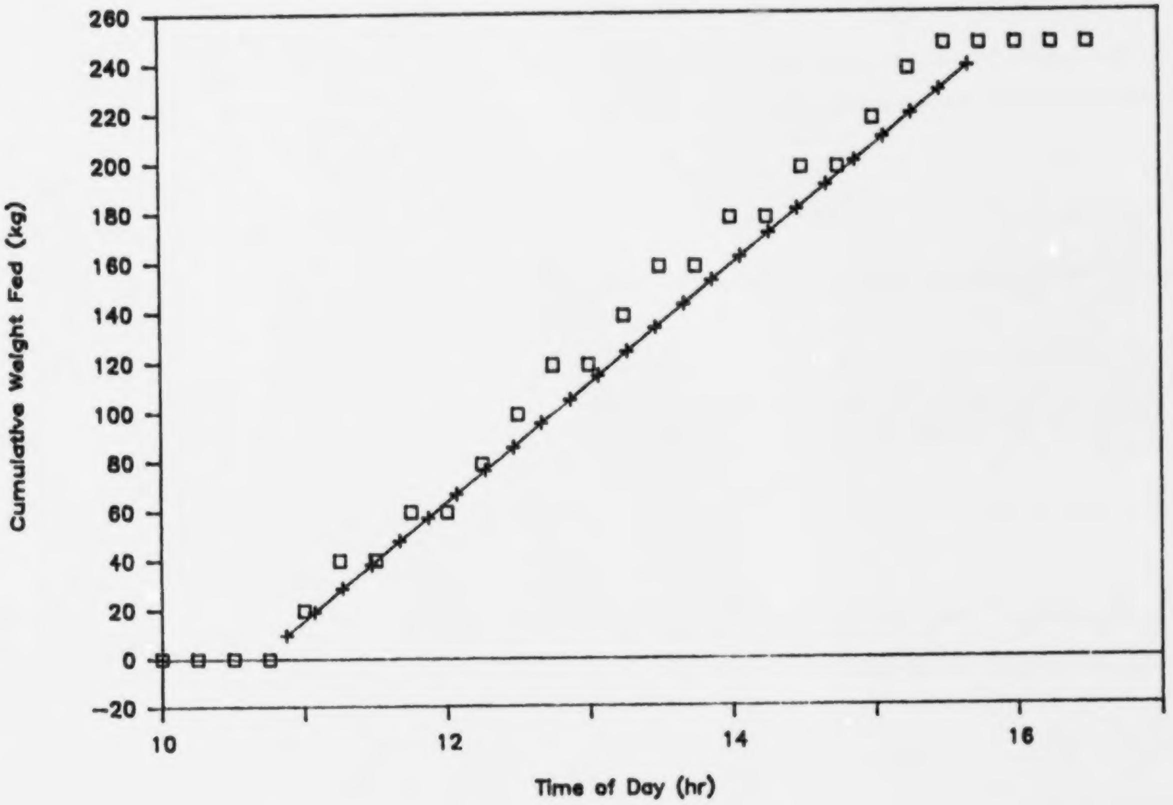

Figure 12. Waste feed schedule for Test 3.

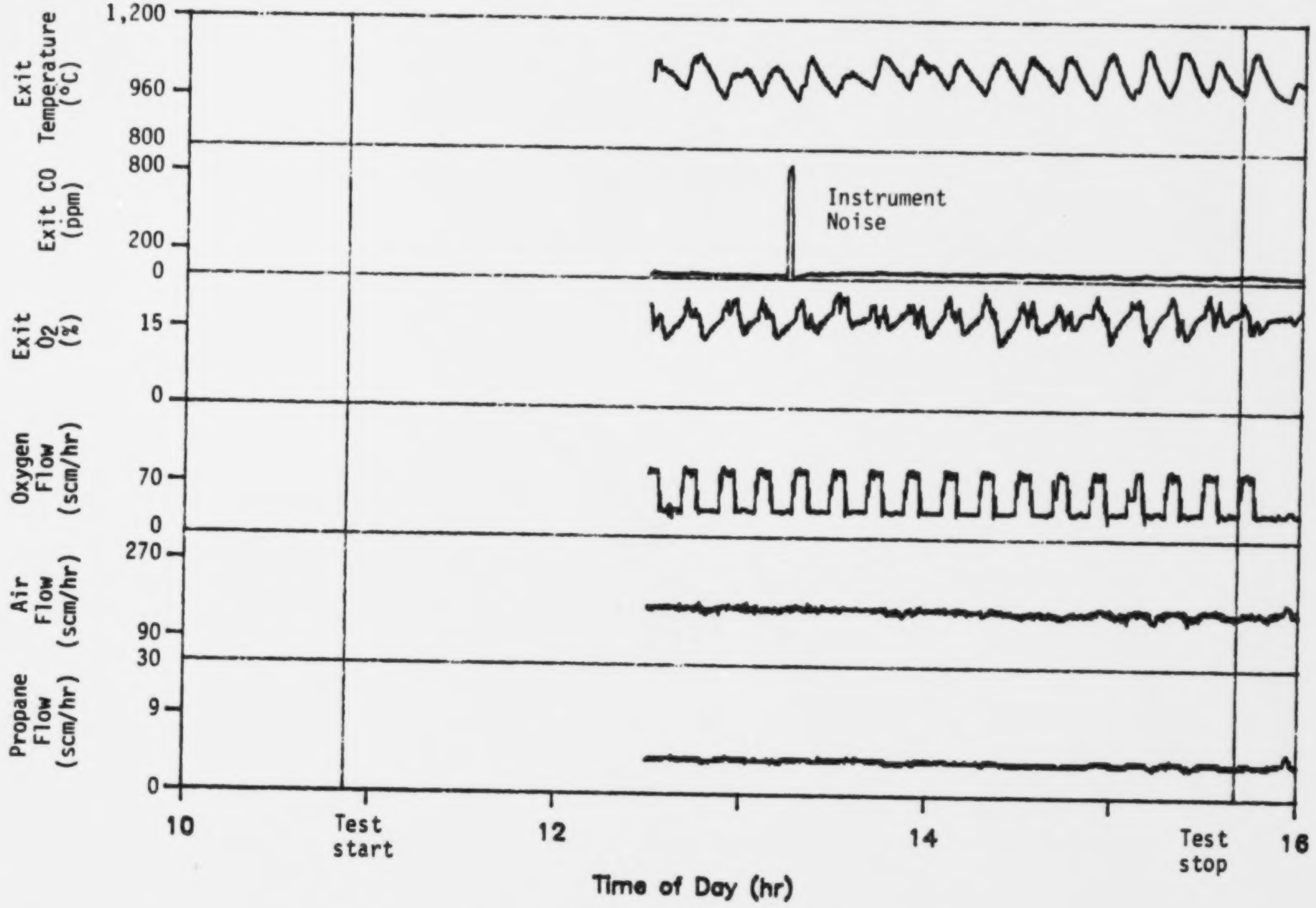

Figure 13a. Kiln data for Test 3.

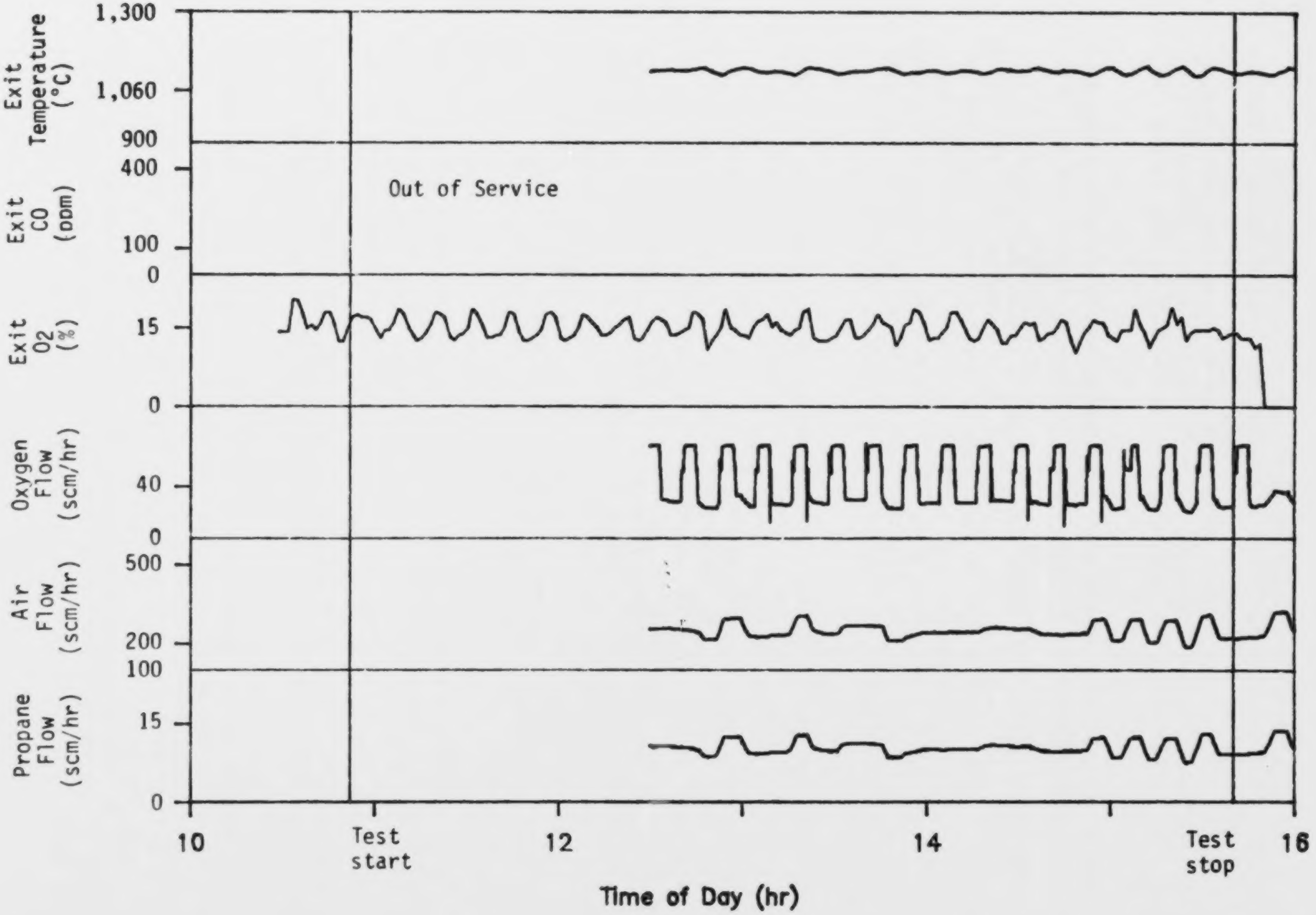

Figure 13b. Afterburner data for Test 3.

the kiln and afterburner are noted for this test in Figure 13. The incinerator process data acquisition system was not functioning for about the first 1.5 hrs of emission sampling. This event is reflected in the gap seen in Figure 13. This initial 1.5-hr period was one of acceptable operation, however. Control room data recorded at 15-min intervals (see Appendix A) confirm that operation during this period was comparable to that during the recorded period shown in Figure 13.

Figure 13 shows that at the same waste feed schedule and kiln propane flow, kiln temperatures were higher for Test 3 than for Tests 1 and 2. This is as expected as diluent N_2 is removed from the oxidant feed. Test 3 kiln exit temperature varied from about 980° to 1,090°C (1,800° to 2,000°F) over a charge cycle. Kiln exit flue gas O_2 was also higher, ranging from about 15 to 21 percent. Kiln exit flue gas CO was steady at about 50 ppm. The stack CO monitor zero drifted during the test as shown in Figure 14. Correcting for this drift, stack CO levels were quite low, no more than a few ppm, throughout the test. The oxygen flowrate traces in Figure 13 show that the only trigger event which caused oxygen flowrates to ramp up for this test was the batch charge event.

Optimization testing for further Pyretron O_2 enhanced operation proceeded in early January 1988. From these tests, it was decided to designate test condition 4 at an increased waste charge mass of 15.5 kg (34 lb) but with decreased charge frequency of every 19.5 min so that total feedrate of 47.7 kg/hr (105 lb/hr) was the same as for Tests 1, 2, and 3. The purpose of this test was to supply data to evaluate the ACI claim that the Pyretron system would be able to reduce the magnitude of transient puffs of CO and unburned hydrocarbon accompanying a batch waste charge. Test 4 was performed at approximately a 60-percent increase in charge mass compared to the maximum achievable with conventional incineration (Tests 1 and 2). The Pyretron system operating control logic was similar to that used in Test 3, discussed previously, with timing adjustments to the batch change event trigger to account for the altered waste charge cycle. Test 4 was completed on January 14, 1988.

Figure 15 shows the waste feed schedule for the test, and Figure 16 shows corresponding kiln and afterburner data. Figure 16 shows that kiln exit temperature was more variable for the high charge mass test (Test 4). Average kiln exit temperature was about 960°C (1,765°F), although temperatures as low as 870°C (1,600°F) and as high as 1,065°C (1,950°F) were routinely experienced. Kiln exit flue gas O_2 generally ranged from about 13 to about 19 percent over a charge cycle. Kiln exit flue gas CO was generally below 10 ppm.

With respect to evaluating the ACI claim that the Pyretron system would be able to reduce the magnitude of transient puffs of CO and unburned hydrocarbon accompanying a batch waste charge, it is interesting to compare the kiln exit CO emissions traces shown in Figures 4a, 7a, 10a, and 16a. As noted above, the attempt to feed 65.6 kg/hr (144 lb/hr) to the kiln with 10.9 kg (24 lb) charges every 10 min under conventional incinerator operation gave rise to unacceptably high transient puffs. Reducing the waste feedrate to 47.7 kg/hr (105 lb/hr) with 9.5 kg (21 lb) charges every 12 min gave much

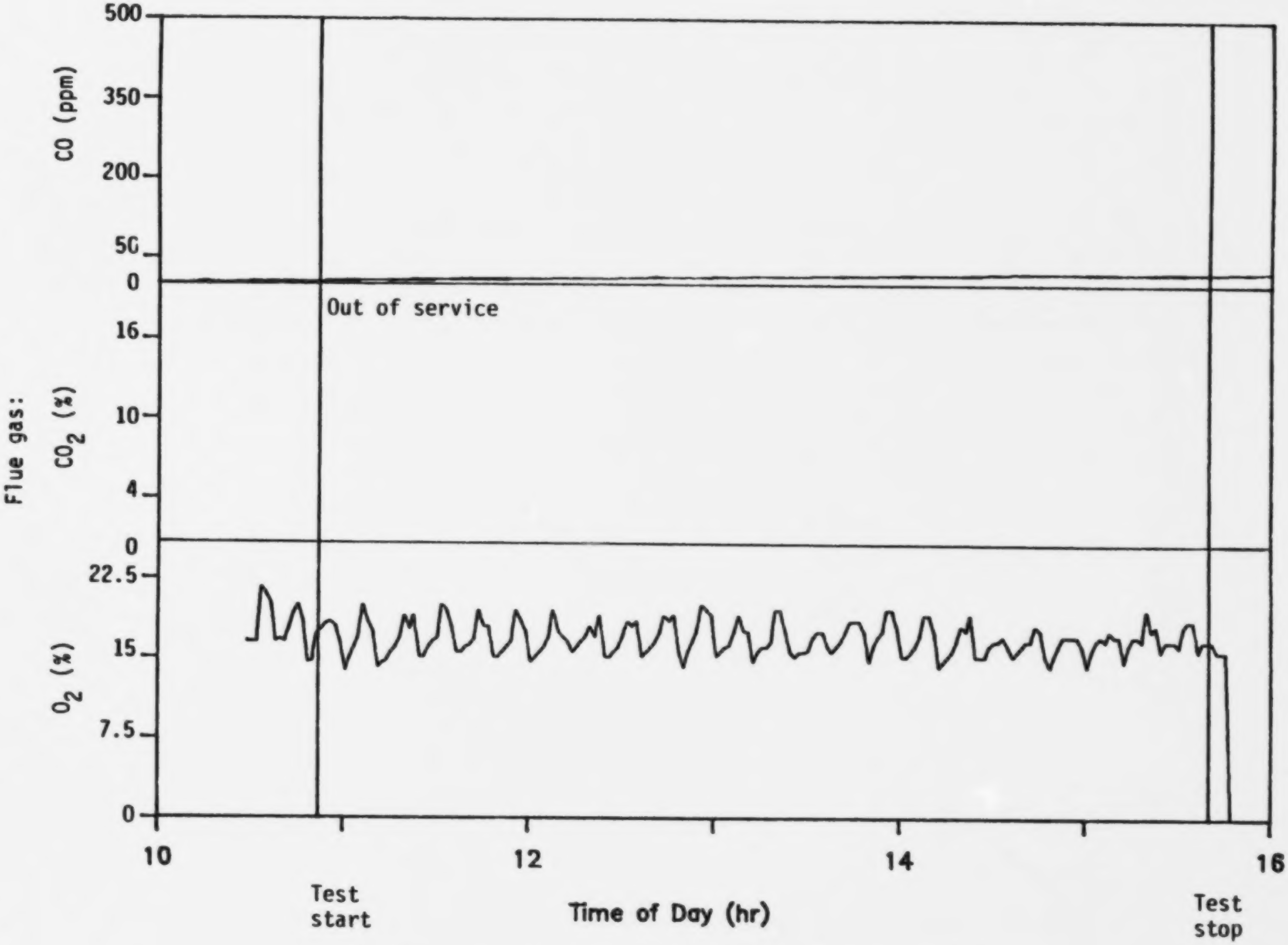

Figure 14. Stack emissions monitor data for Test 3.

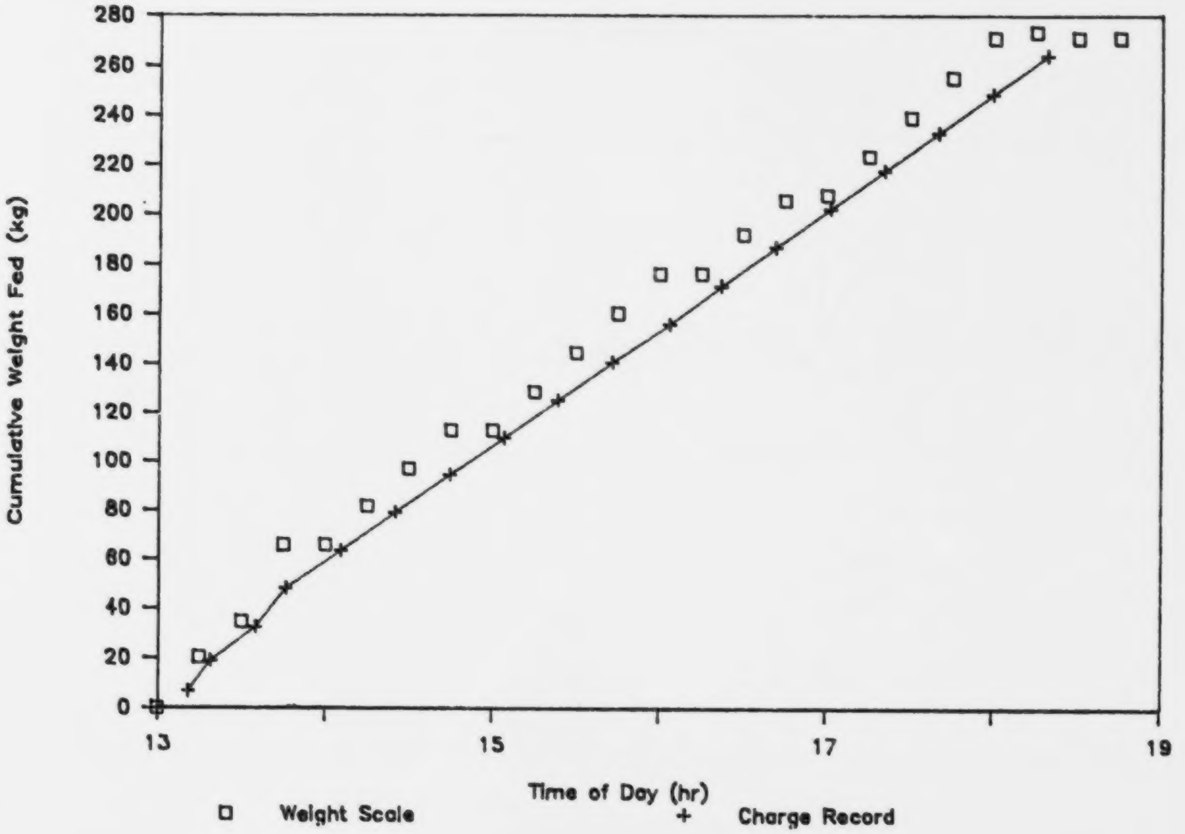

Figure 15. Waste feed schedule for Test 4.

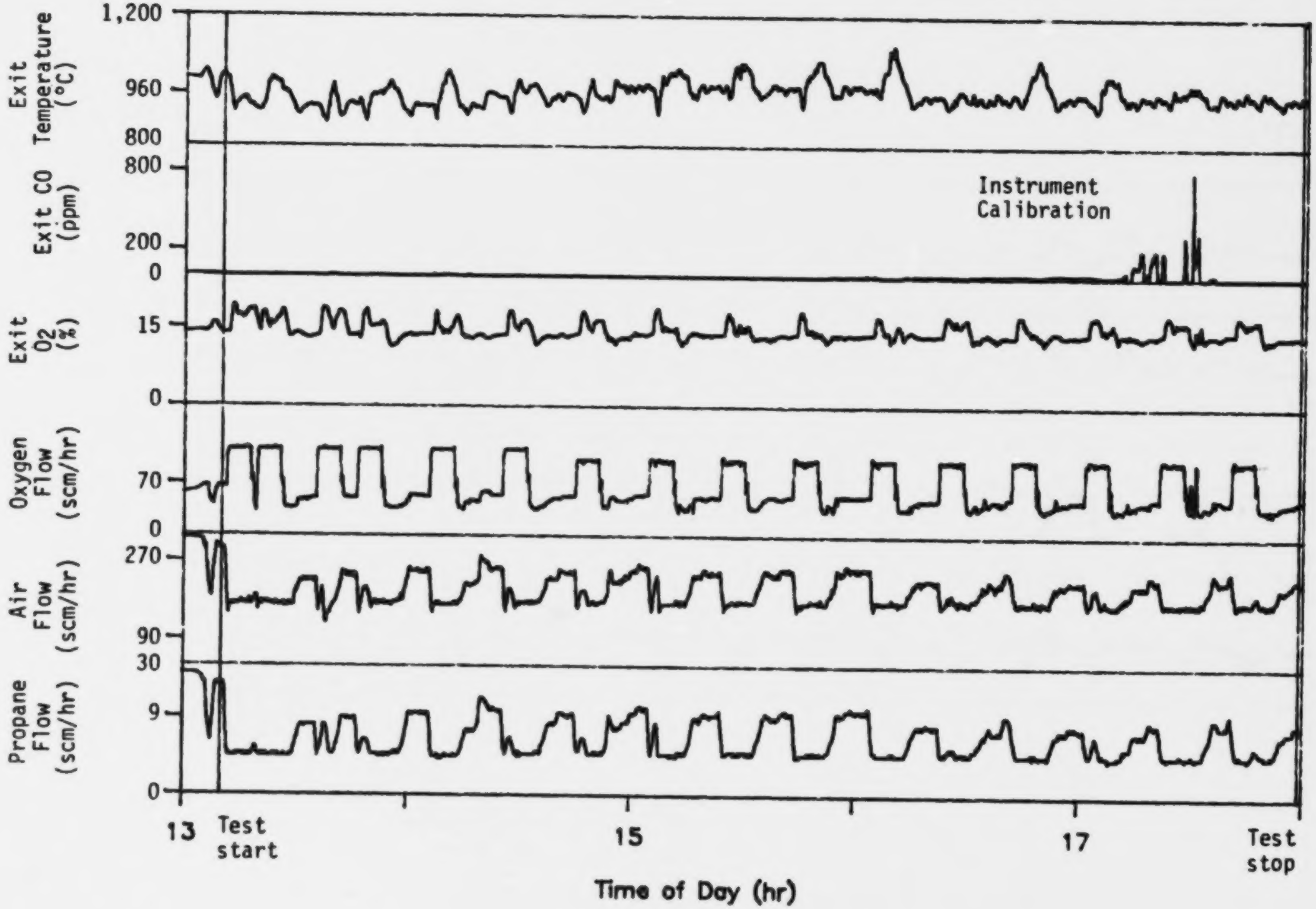

Figure 16a. Kiln data for Test 4.

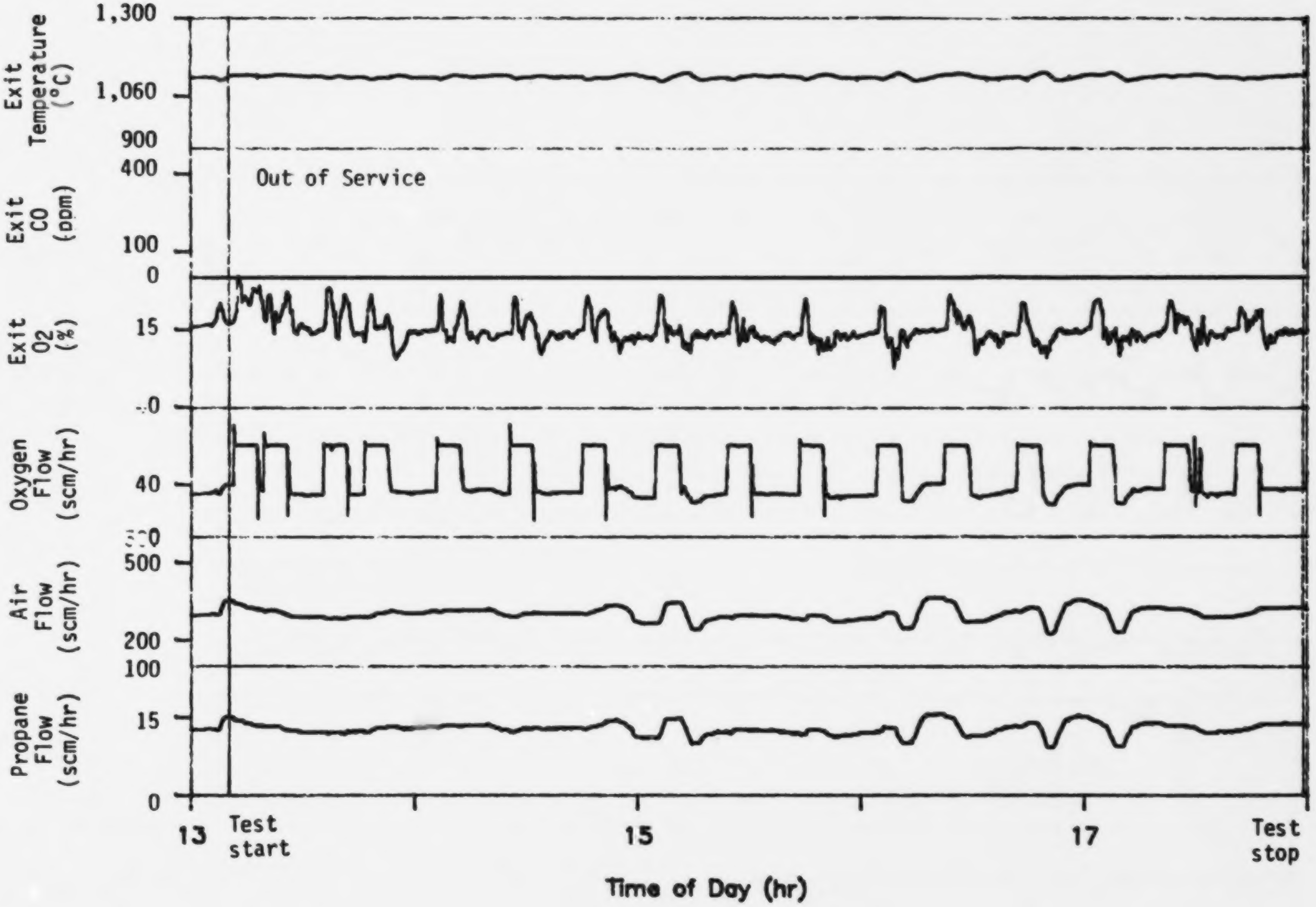

Figure 16b. Afterburner data for Test 4.

more acceptable conventional incinerator operation. The first conventional incineration test at this feed schedule (Test 1) resulted in relatively low and steady kiln exit CO levels (see Figure 7a). The second test at this feed schedule (Test 2) resulted in generally steady kiln exit CO levels, although several CO spikes occurred (see Figure 10a).

The test under Pyretron O_2 enhanced operation at increased charge mass (15.5 kg (34 lb) every 19.5 min) but constant feedrate (47.7 kg/hr (105 lb/hr)) (Test 4) resulted in low and steady kiln exit CO levels (see Figure 16a) comparable to the emissions trace for Test 1. However, a clear conclusion regarding the capability of the Pyretron sytem to reduce the magnitude of transient puffs is not possible based on the kiln exit CO level data. Test-to-test variations in the CO monitor readings were such that no clear differences between conventional incineration and Pyretron performance were apparent.

Test 5 was performed at the same charge mass as for Tests 1, 2, and 3 but with charge frequency doubled. The feed schedule for this test, thus, was 9.5 kg (21 lb) every 6 min, or 95.5 kg/hr (210 lb/hr). This rate represents double the waste feedrate achievable under conventional operation. The purpose of this test was to evaluate the ACI claim that the Pyretron system was capable of incinerating waste in compliance with incinerator performance standards but at higher waste feedrates than are possible with conventional incineration. Test 5 was completed on January 20, 1988.

Although it was possible to double the waste feedrate for this test over that achievable under conventional operation, the increased heat input to the kiln at this increased feedrate necessitated the use of kiln water injection to afford additional kiln temperature control. Previous Pyretron O_2 enhanced tests were performed without the need for kiln water injection. However, for Test 5 water was atomized into the kiln at a location near the kiln auxiliary fuel burner at a constant rate of 2.3 L/min (0.6 gpm). This rate of water injection was required to keep kiln temperatures near the target value.

Figure 17 shows the waste feed schedule for Test 5. Figure 18 shows corresponding kiln and afterburner data for Test 5. As for Test 4, kiln exit temperature exhibited greater variation over a charge cycle than experienced under conventional operation or for Test 3. Average kiln temperature was about 980°C (1,795°F), although temperatures as low as 900°C (1,650°F) and as high as 1,065°C (1,950°F) were routinely experienced. Kiln exit flue gas O_2 varied from about 11 percent to 16 percent over most of the test. Kiln exit flue gas CO was generally about 100 ppm, although occasional 600-ppm peaks were experienced. Upon passage through the afterburner, these peaks were reduced to 30 ppm or below.

The replicate test of test condition 5, designated Test 6, was completed on January 21, 1988. Kiln water injection at 2.3 L/min (0.6 gpm) was used for this test as well. Figure 19 shows the waste feed schedule for this test, and Figure 20 shows corresponding kiln and afterburner data. The kiln exit temperature variation for this test was less than that experienced for Test 5. Average kiln exit temperature was about 980°C (1,795°F) with routine variations from about 925°C (1,700°F) to about 1,035°C (1,900°F). Kiln exit

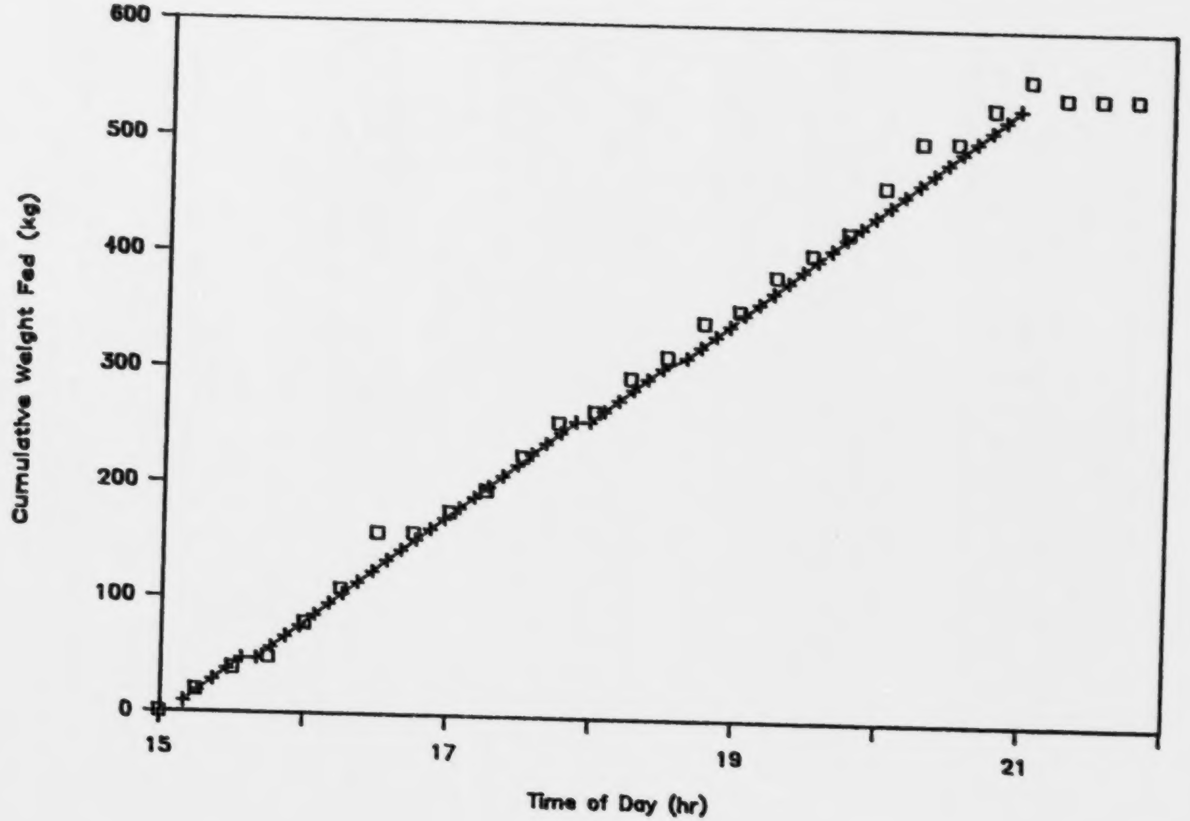

Figure 17. Waste feed schedule for Test 5.

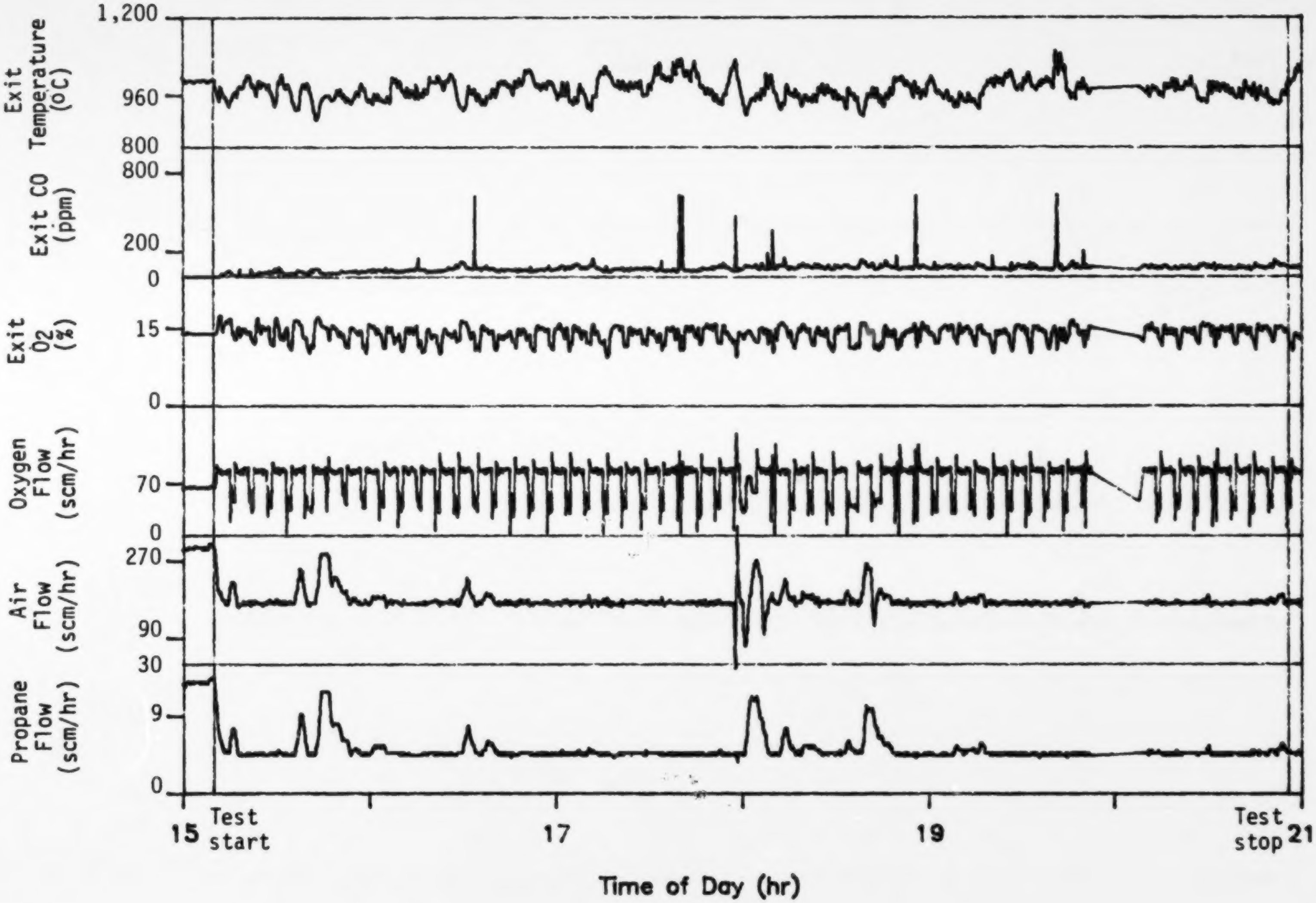

Figure 18a. Kiln data for Test 5.

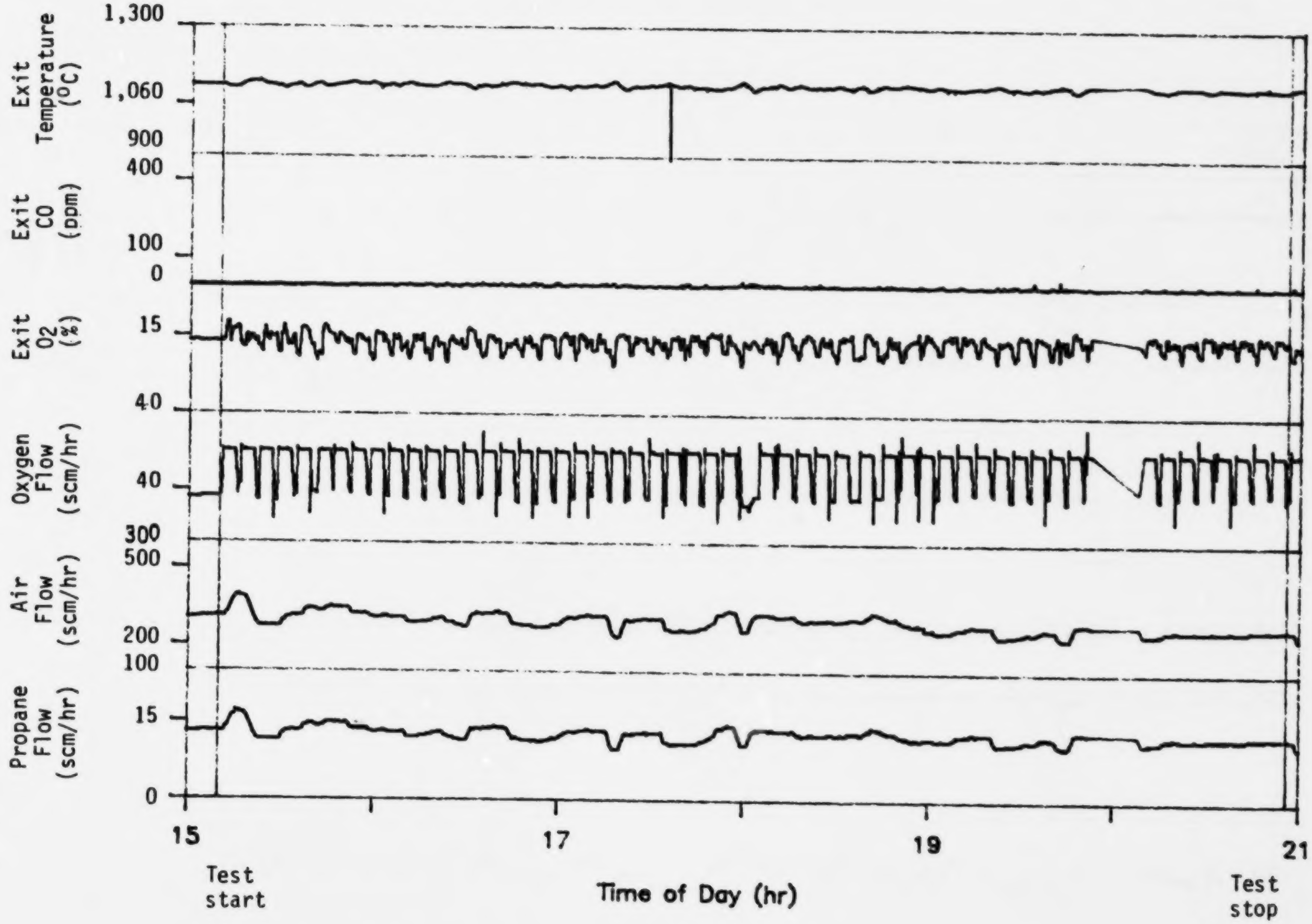

Figure 18b. Afterburner data for Test 5.

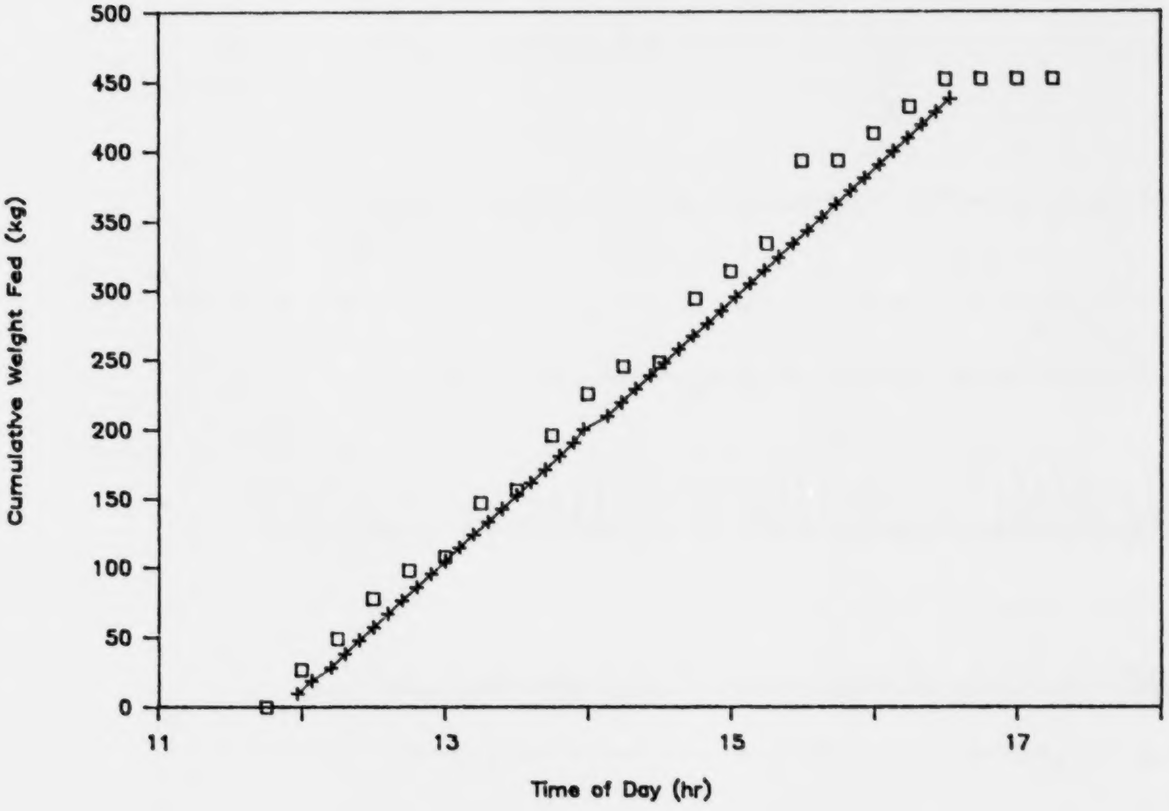

Figure 19. Waste feed schedule for Test 6.

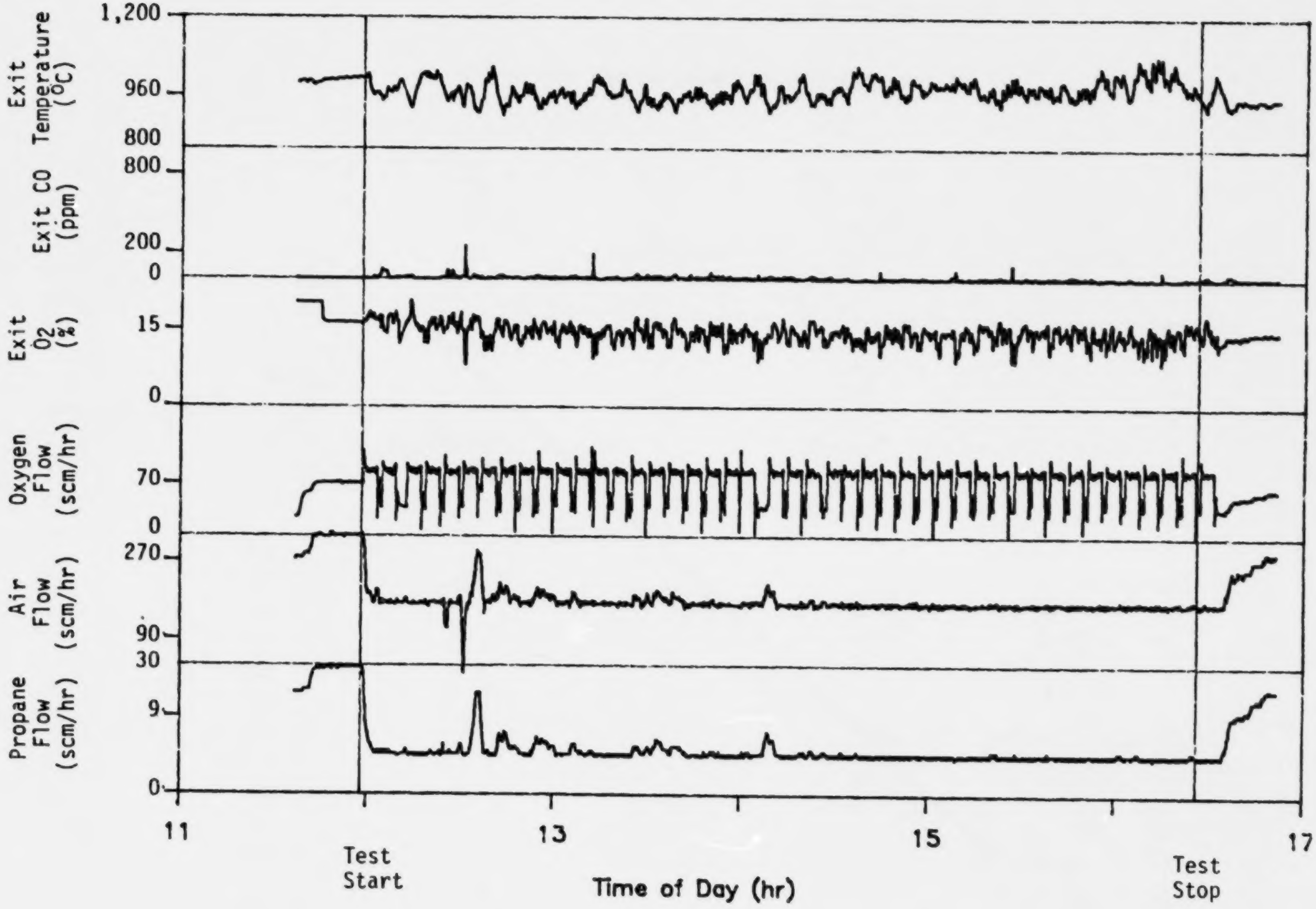

Figure 20a. Kiln data for Test 6.

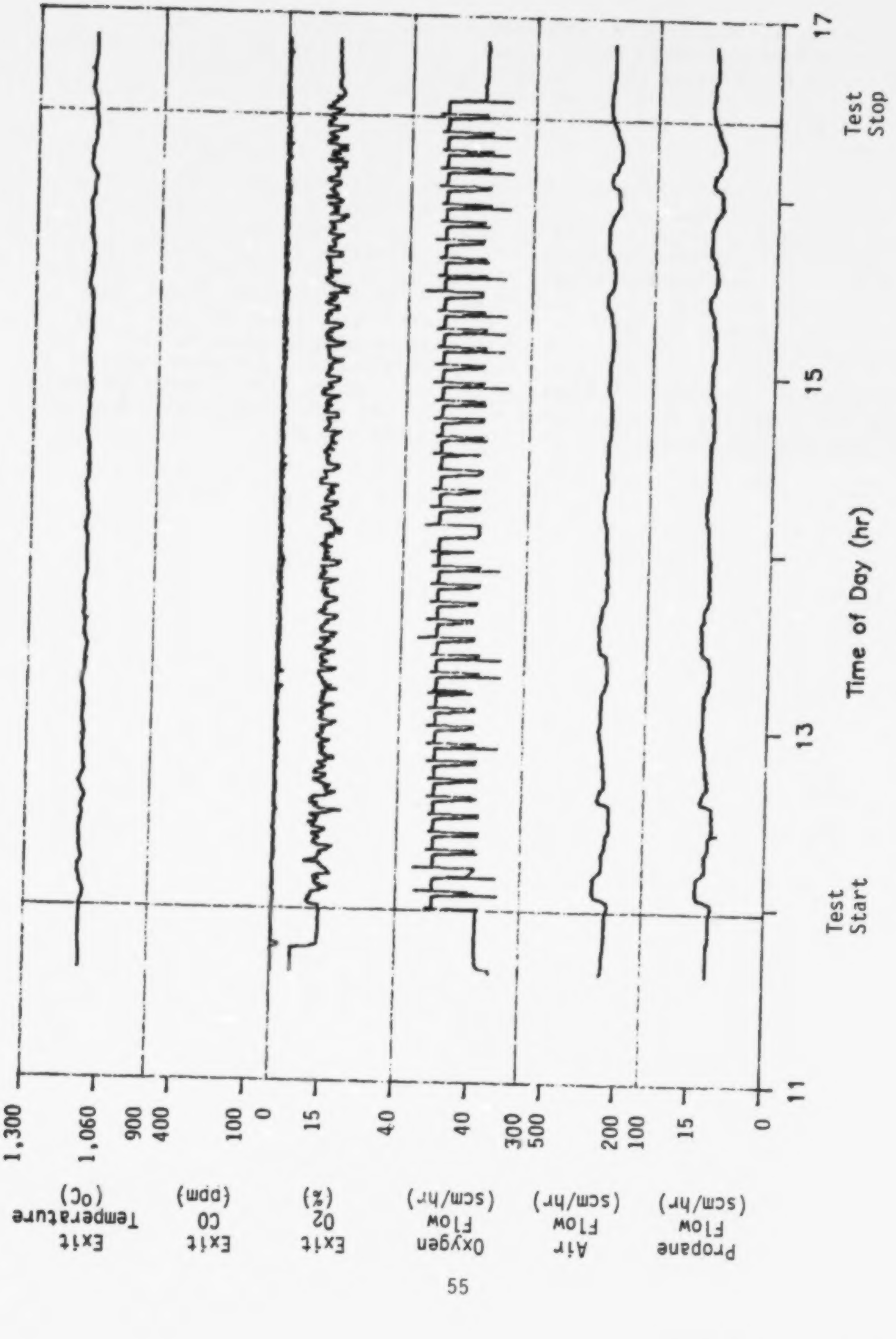

Figure 20b. Afterburner data for Test 6.

flue gas O_2 variations were comparable to those experienced in Test 5, generally ranging from 11 to 17 percent. Kiln exit flue gas CO peaks of about 100 to 300 ppm occurred when kiln exit O_2 fell below about 10 percent. However, for other than these periods, CO levels in the kiln exit flue gas were usually about 30 ppm. Afterburner flue gas CO was steady at less than 10 ppm.

The two planned tests with Stringfellow waste alone (no K087, although spiked with 4,500 ppm each of hexachloroethane and 1,3,5-trichlorobenzene) were completed on January 27 and 29, 1988. Test 7 under Pyretron O_2 enhanced operation was completed on January 27; Test condition 8 under conventional operation was completed on January 29. The waste feed schedule for both tests was a charge of 3.6 kg (8 lb) every 4 min, or 54.5 kg/hr (120 lb/hr). The waste feed schedule and the kiln and afterburner data plots for Test 7 are given in Figures 21 and 22, respectively. Corresponding plots for Test 8 are given in Figures 23 and 24. Since the Stringfellow soil contained negligible heat content and, thereby, offered no challenge to the kiln, Figures 22 and 24 show that both kiln and afterburner operation was quite steady, with generally no significant operating transients over a waste charge cycle.

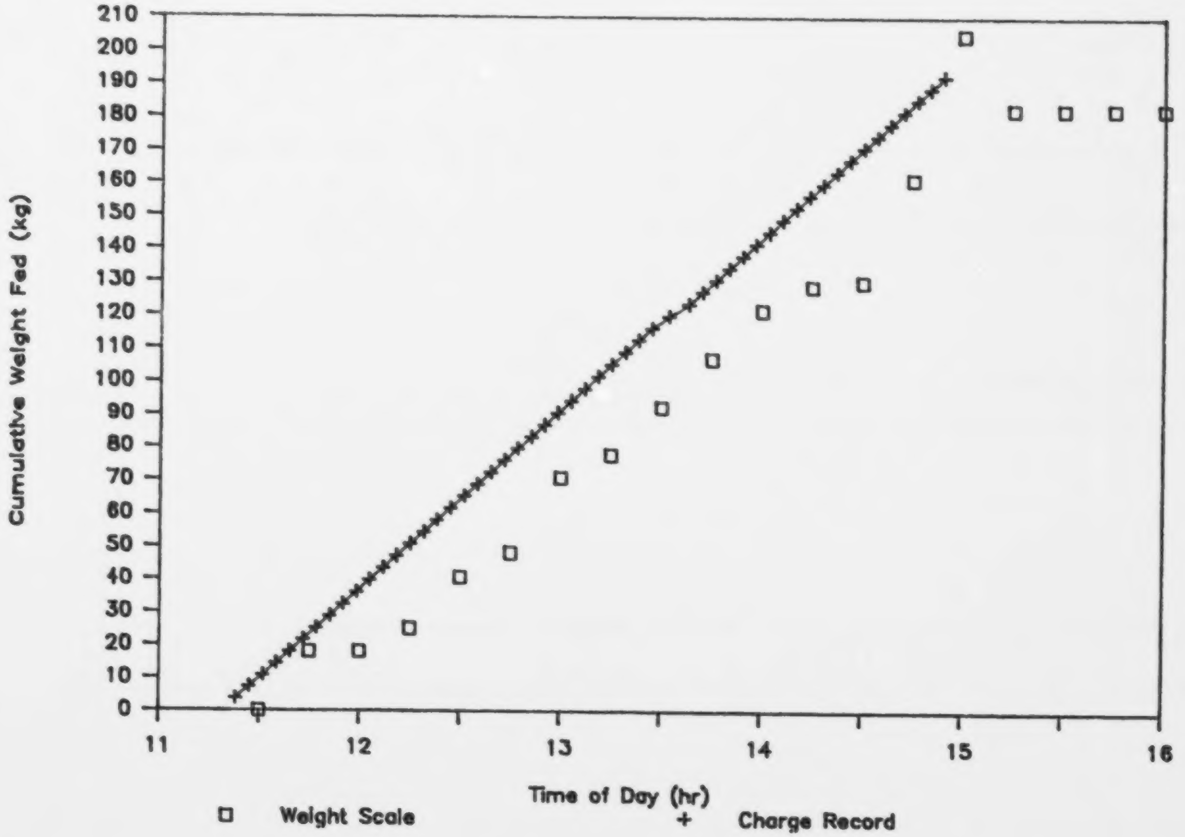

Figure 21. Waste feed schedule for Test 7.

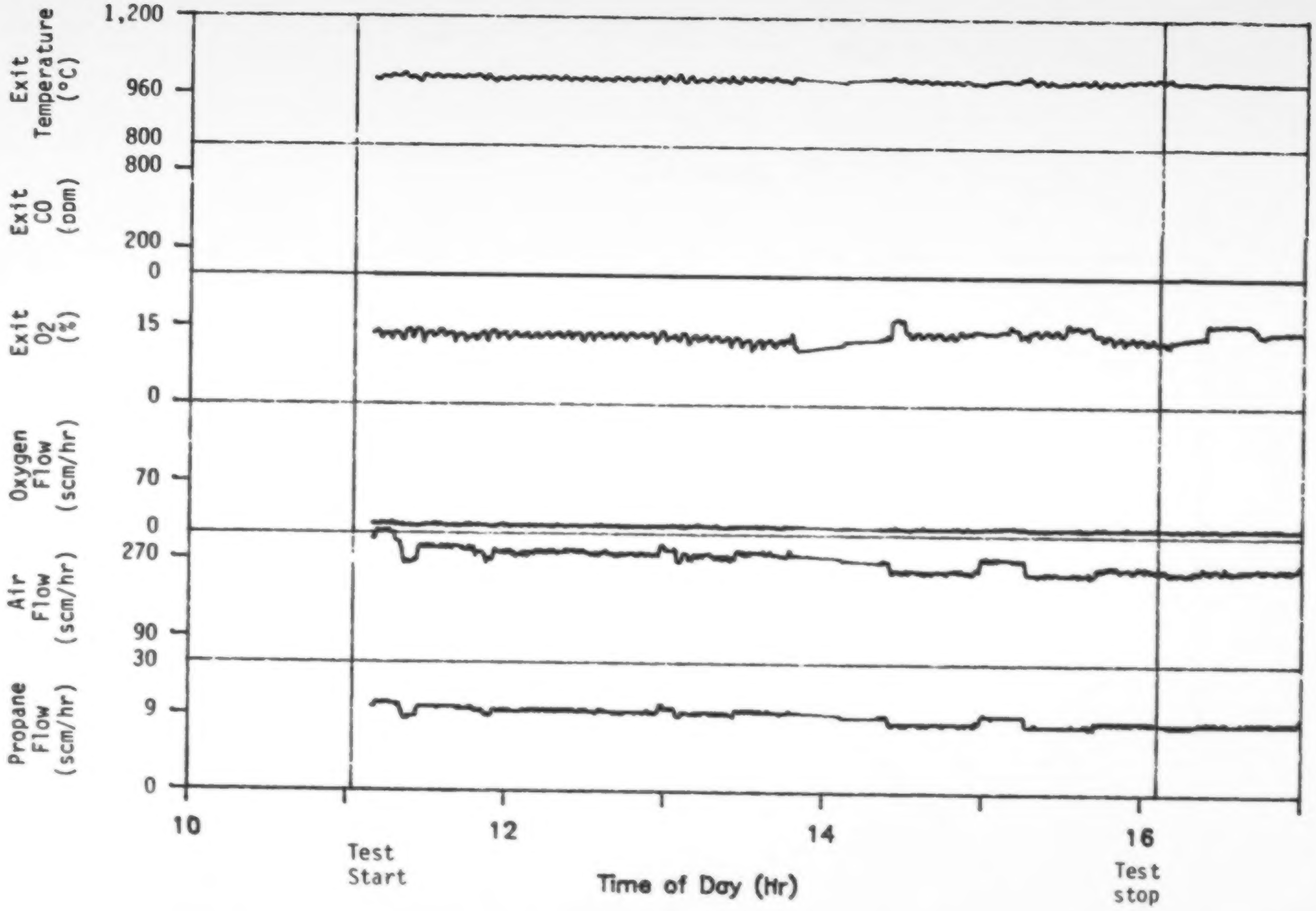

Figure 22a. Kiln data for Test 7.

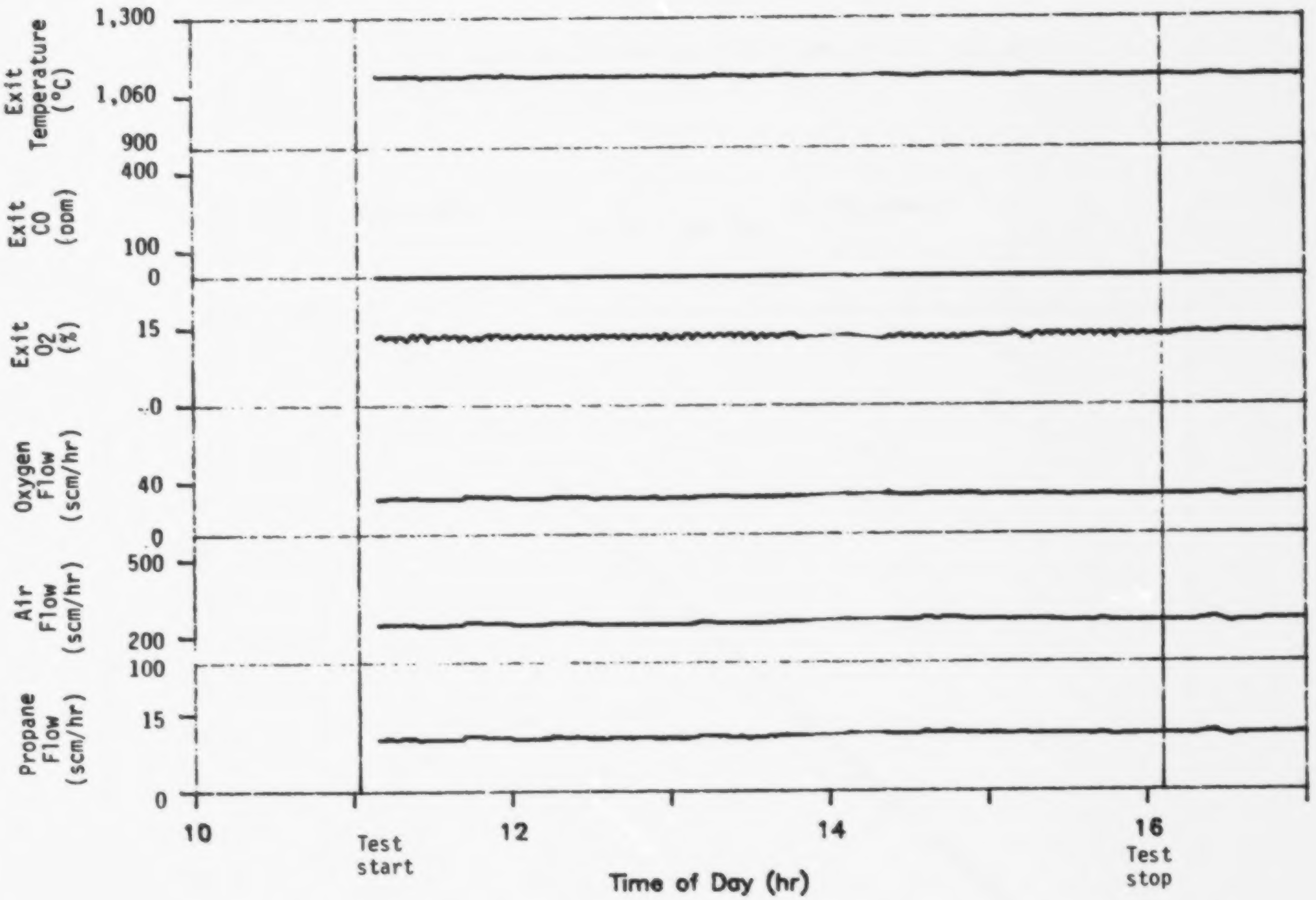

Figure 22b. Afterburner data for Test 7.

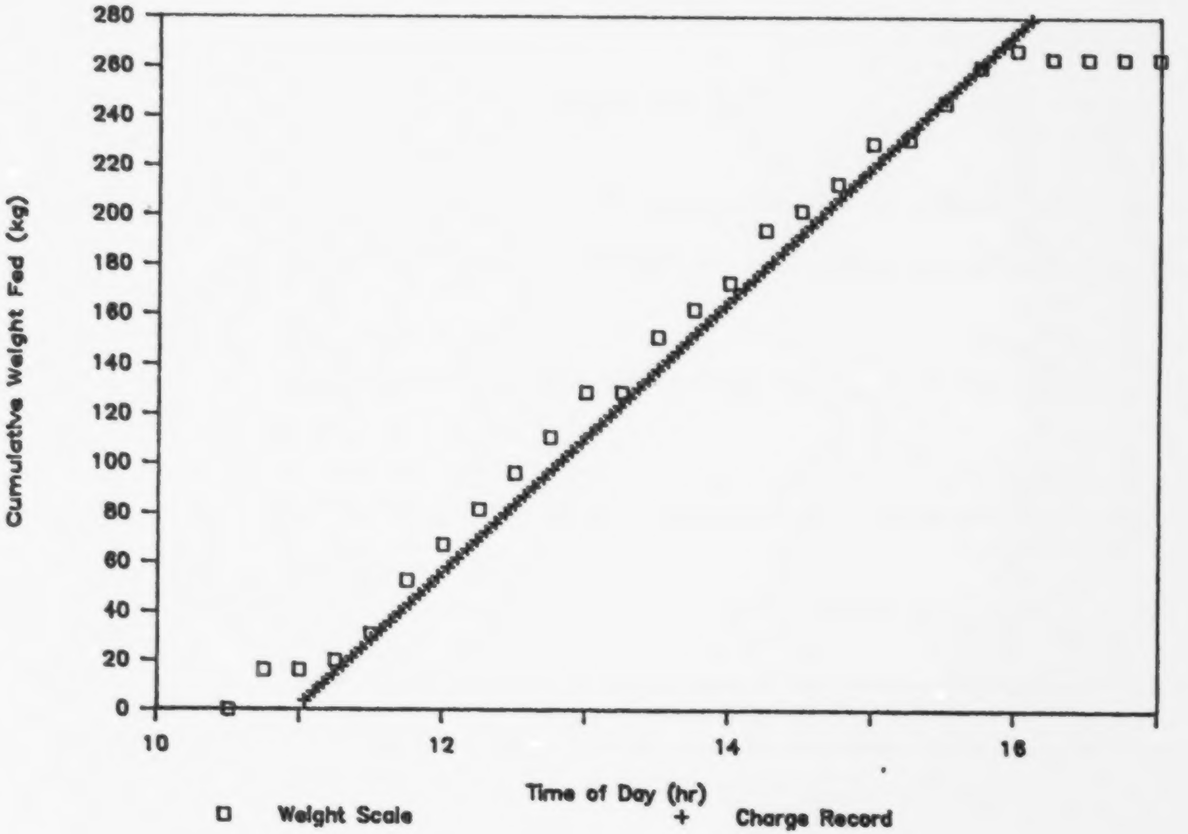

Figure 23. Waste feed schedule for Test 8.

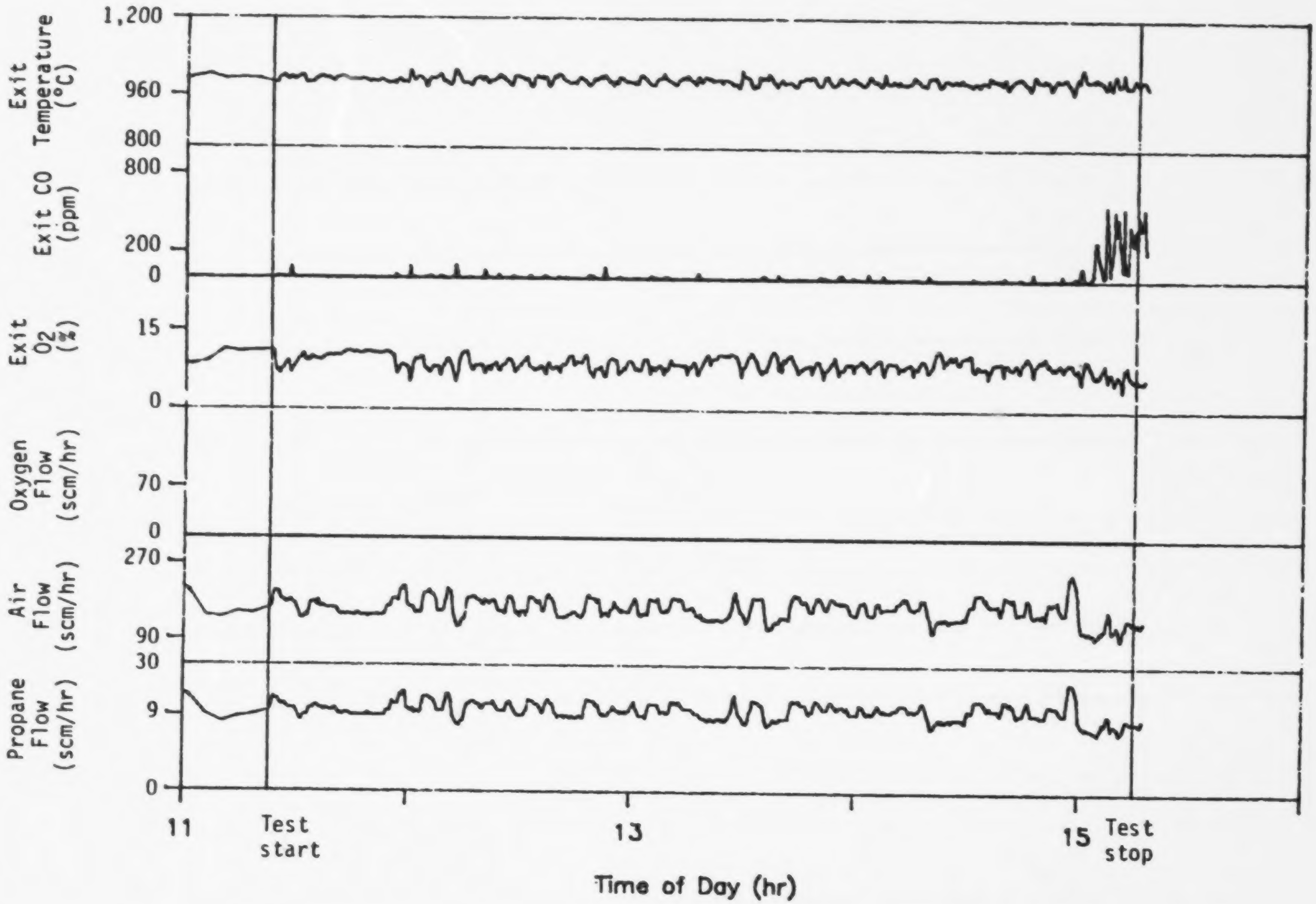

Figure 24a. Kiln data for the conventional incineration test with Stringfellow soil alone.

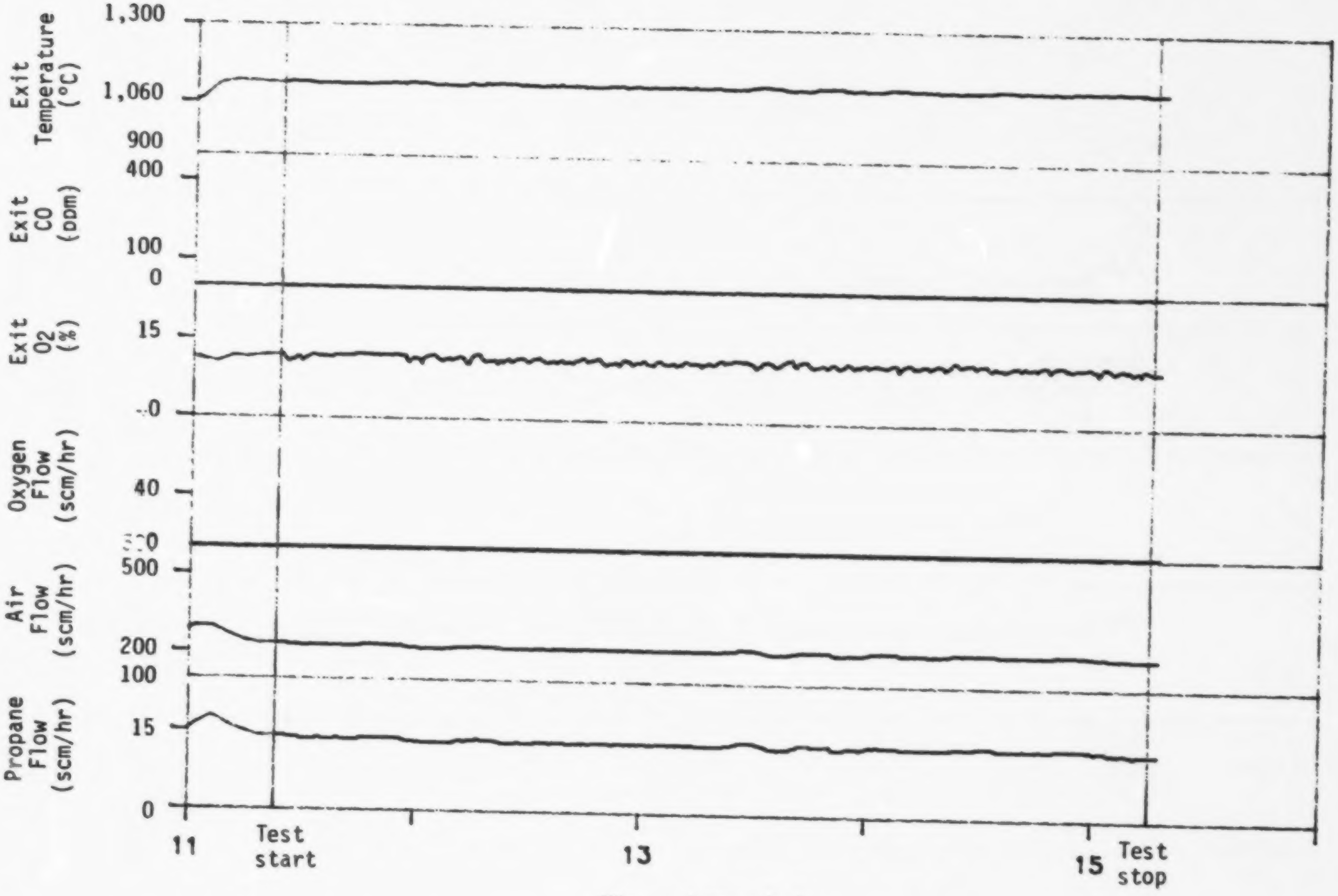

Figure 24b. Afterburner data for Test 8.

SECTION 6

SAMPLING AND ANALYSIS MATRIX

An extensive sampling and analysis effort was performed to support the demonstration test program. This effort is summarized in Table 9. As noted in Table 9, the sampling matrix included:

- Obtaining composite samples of the waste feed, kiln ash, and scrubber blowdown over each test period
- Sampling the flue gas downstream of the scrubber system and in the stack for semivolatile organics using Modified Method 5 (Method 0010, (4))
- Sampling the flue gas downstream of the scrubber system and in the stack for particulate using Method 5 (5)
- Measuring flue gas O_2, CO_2, CO, and total unburned hydrocarbon (TUHC) at the kiln and afterburner exits using continuous emission monitors (CEMs)

Composite samples of the waste feed were prepared by opening about every tenth fiberpack drum and removing approximately 100 mL of feed. These grab samples were combined to give one composite sample for each test.

Composite samples of scrubber blowdown were collected by taking tap samples every 1.5 hrs over the test duration beginning 1 hr after test initiation. Composite samples of kiln ash were taken from the ash bin which collected ash for a given test (a clean ash bin was inserted before each test).

In addition to flue gas O_2, CO_2, CO, and TUHC monitoring at various locations as noted above, the flue gas was sampled for particulate and semivolatile organic hazardous constituents. Method 5 and Modified Method 5 (MM5, Method 0010) sampling was performed in the scrubber discharge flue gas and in the stack. MM5 sampling in the scrubber discharge flue gas was performed for all tests. Simultaneous MM5 sampling at this location was performed for Tests 1, 2, 5, and 6. Method 5 sampling was performed in the scrubber discharge flue gas for all tests except Tests 1, 2, 5, and 6. Method 5 and MM5 sampling of the stack gas was performed for all tests except MM5 sampling for Tests 1 and 6.

TABLE 9. SAMPLING AND ANALYSIS MATRIX SUMMARY

Stream	Location	Sampling procedure	Parameter	Method	Frequency
Waste feed	Rotary kiln inlet	Grab/composite	Proximate analysis (ash, moisture, volatile, matter, heating value)	A100[a]	Tests 1 through 6 combined composite, Tests 7 and 8 combined composite
			Ultimate analysis (C, H, O, N, S, Cl)	A003[a]	Tests 1 through 6 combined composite, Tests 7 and 8 combined composite
			Semivolatile organic hazardous constituents	8270[b]	1 composite/test, all tests
Kiln ash	Kiln ash discharge	Grab/composite	Semivolatile organic hazardous constituents	8720[b]	1 composite/test, except Tests 1 and 6
Scrubber blowdown	Blowdown discharge	Composite tap	Semivolatile organic hazardous constituents	8720[b]	1 composite/test, except Tests 1 and 6
Flue gas	Kiln exit	Extractive	O_2, CO_2, CO, TUHC HC	Continuous emission monitor	All tests
	Afterburner exit	Extractive	O_2, CO_2, CO, TUHC	Continuous emission monitor	All tests
	Packed tower scrubber exit	Method 5[c]	Particulate	Method 5[c]	1 per test for all tests, except Tests 1, 2, 5, and 6
		Method 0010[b]	Semivolatile organic hazardous constituents	8270[b]	1 per test for all tests; simultaneous 2 per test for Tests 1, 2, 5, and 6
	Stack, downstream of carbon bed/HEPA filter	Method 5[c]	Particulate	Method 5[c]	1 per test for all tests
		Method 0010[b]	Semivolatile organic hazardous constituents	8270[b]	1 per test for all tests except Tests 1 and 6
		Extractive	O_2, CO_2, CO	Continuous emission monitor	Continuous, all tests

[a] (3)
[b] (4)
[c] (5)

The laboratory analysis procedures used to characterize the samples collected via the test matrix included:

- Subjecting combined composite feed samples from Tests 1 through 6 and from Tests 7 and 8 to proximate (moisture, ash, volatile matter, heating value) and ultimate (C, H, O, N, S, Cl) analysis
- Analyzing the composite feed, the composite kiln ash, the composite blowdown water, and all MM5 train samples for each test for semivolatile organic hazardous constituents

Waste proximate/ultimate analyses were performed in accordance with approved ASTM methods as documented in (3). Semivolatile organic compound analyses were performed by Method 8270. Appropriate extraction procedures as recommended in Method 8270 for different sample types were employed. For feed samples, 1 to 5 g was extracted for analysis; 1 L of scrubber blowdown and 50 g of kiln ash were extracted for analysis.

SECTION 7

TEST RESULTS

Test results are presented and discussed in this section. Continuous emission monitor (CEM) data are presented Section 7.1. Section 7.2 discusses the POHC DRE results obtained. Particulate emissions are summarized in Section 7.3, and residuals analysis results presented in Section 7.4.

7.1 CONTINUOUS EMISSIONS MONITOR DATA

In accordance with the test plan, O_2, CO_2, CO, and TUHC were monitored at the kiln and afterburner exits; and O_2, CO_2, and CO were monitored at the stack. The full complement of monitors was in operation for Tests 5, 6, 7, and 8. Some monitors were out of service during Tests 1, 2, 3, and 4. Table 10 itemizes the monitors that were in operation for each test. (Monitors noted as out of service for a given test had failed prior to or during preparations for a test and were being repaired or replaced.) As shown in Table 10, only O_2, CO, and TUHC at the kiln exit; O_2 and TUHC at the afterburner exit; and O_2 at the stack were continuously monitored during all tests. The afterburner exit CO monitor was out of service for Tests 1, 2, 3, and 4. The stack CO_2 monitor was out of service for Tests 1, 2, and 3. The kiln and afterburner exit CO_2 and the stack CO monitors were out of service for Test 4. Some tests were initiated without a full complement of monitors in operation, and some tests were continued when specific monitors failed because the specific inoperative monitors were not critical to satisfying test objectives as explained in the following discussion.

With respect to the evaluation of ACI claims regarding the Pyretron system, the most important measurements are the kiln exit O_2, CO, and TUHC levels. These were indeed monitored in all tests. Afterburner exit O_2 and either afterburner exit or stack CO are useful though not critical for the evaluation of the ACI claims. These were continuously monitored for all tests except Test 4 (CO missing). For this test, the TUHC measurement was available at the afterburner exit. Because of this availability and the behavior of kiln exit CO as discussed in Section 5, lack of an afterburner exit or stack CO measurement for this one test would not detract from the evaluation of the ACI claims (see Section 1) in these tests.

Therefore, the lack of the full test plan complement of monitors, as documented in Table 10, did not detract from the ability to evaluate the Pyretron process. For all tests, a sufficient complement of monitors was in operation to establish that transient emissions following a batch waste charge were acceptable.

TABLE 10. CEMs IN OPERATION FOR THE DEMONSTRATION TESTS

Monitor	Test 3a (12-9-87)	Test 3 (12-11-87)	Test 4 (12-18-87)	Test 5 (1-14-88)	Test 6 (1-20-88)	Test 6a (1-21-88)	Test 2 (1-27-88)	Test 1 (1-29-88)
Kiln exit:								
O_2	X	X	X	X	X	X	X	X
CO_2	X	X	X		X	X	X	X
CO	X	X	X	X	X	X	X	X
TUHC	X	X	X	X	X	X	X	X
Afterburner exit:								
O_2	X	X	X	X	X	X	X	X
CO_2	X	X	X		X	X	X	X
CO					X	X	X	X
TUHC	X	X	X	X	X	X	X	X
Stack:								
O_2	X	X	X	X	X	X	X	X
CO_2				X	X	X	X	X
CO	X	X	X		X	X	X	X

Figures 25 through 32 show plots of measured flue gas O_2, CO_2, CO, and TUHC at kiln exit, afterburner exit, and stack locations for Tests 1 through 8, respectively. The O_2 and CO data and their variations with batch waste charging for each test condition were discussed in Section 5.2.2. The addition of the CO_2 traces in Figure 25 through 32 shows that, as expected, flue gas CO_2 levels also vary with waste charge cycle but inversely with flue gas O_2.

Flue gas TUHC levels were always less than 10 ppm. The apparent afterburner exit flue gas TUHC spikes of up to 50 ppm for Test 4 shown in Figure 28b are instrument noise.

7.2 PRINCIPAL ORGANIC HAZARDOUS CONSTITUENT DESTRUCTION AND REMOVAL EFFICIENCIES

Table 11 presents the ultimate analysis results for the two composite feed samples analyzed (the composite Stingfellow soil feed used in Tests 7 and 8 and the composite mixed K087/Stingfellow waste fed for Tests 1 through 6). As shown, the soil alone had negligible heating value; the mixed waste heating value was 24.16 MJ/kg (10,410 Btu/lb).

Results of the composite waste feed analyses for POHCs and other semivolatile organic hazardous constituents are summarized in Table 12 for all the tests performed. The table also notes the total amount of waste fed over appropriate sampling periods (scrubber discharge flue gas and stack gas) for each test. The information shown in Table 12 suffices to calculate individual POHC feedrates for each test.

Results of the Method 8270 analyses of all MM5 train samples taken are summarized in Tables 13 (scrubber discharge flue gas trains) and 14 (stack gas trains). Stack gas train data are missing for Test 4. The vial containing the base/neutral extract for this train broke during shipment to the analytical laboratory. The data in Tables 13 and 14 show that none of the PAH compounds designated as POHCs for the mixed K087/Stringfellow waste tests (Tests 1 through 6) were measured in any flue gas MM5 train above the method detection limit (20 to 40 μg/train for all except one sampling train). Hexachloroethane was measured in both the scrubber discharge flue gas and the stack gas for Tests 5 and 7. Hexachloroethane was a POHC for Test 7, in which only Stringfellow waste spiked with hexachloroethane and 1,3,5-trichlorobenzene was tested, but not for Test 5 in which the K087/Stringfellow waste mixture was tested. The compound 2,4-dichlorophenol was found at low levels in one scrubber discharge flue gas train for Test 6.

One or more phthalate compounds were analyzed in virtually all MM5 train samples. The most common phthalate found was bis(2-ethylhexyl)phthalate, which was measured in all but three of the 18 MM5 train samples at levels up to 2,600 μg/train. Butylbenzylphthalate was found in two train samples; Di-n-octyl phthalate was found in eight train samples.

Phthalates are common contaminants often found in routine Method 8270 analyses of environmental sample extracts. Evidence of this is given in

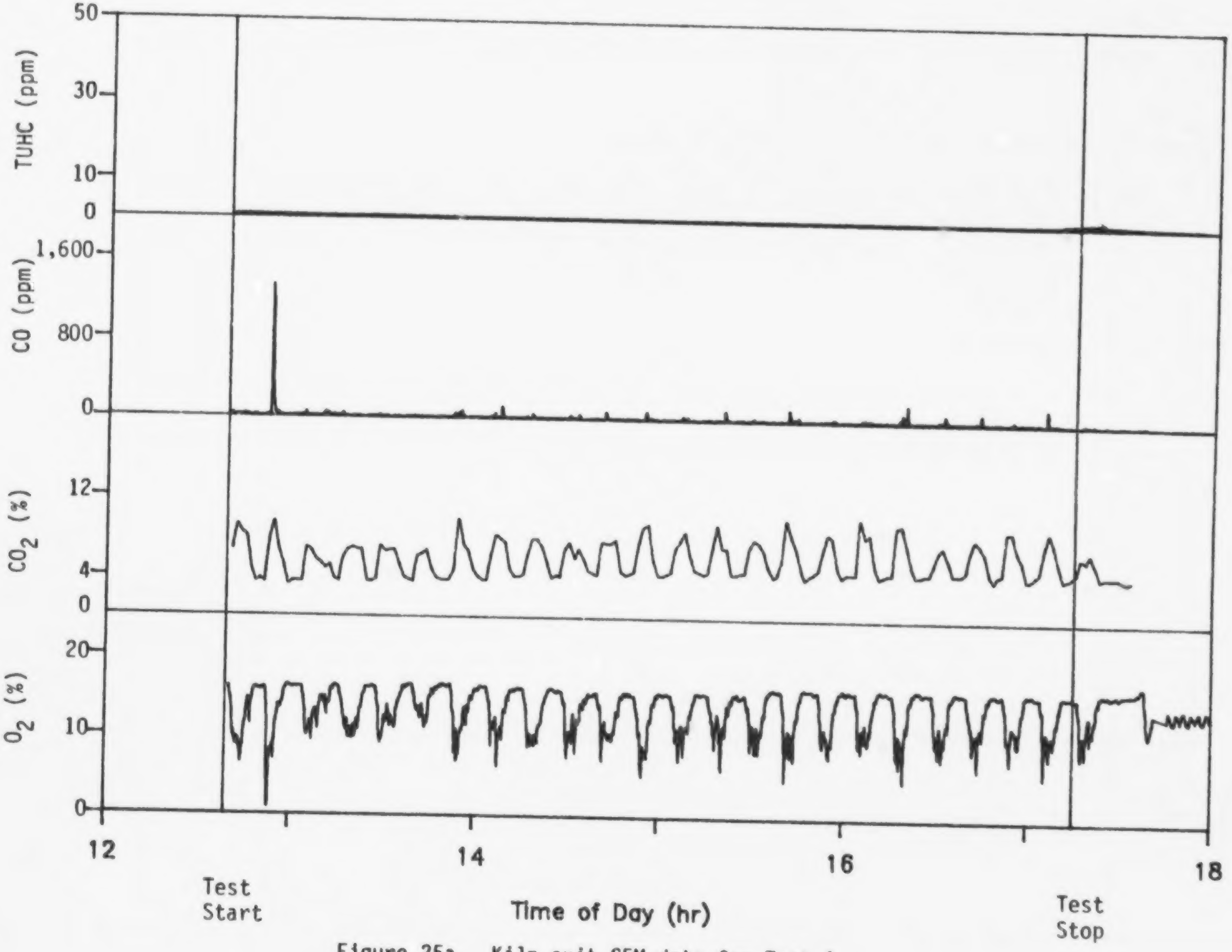

Figure 25a. Kiln exit CEM data for Test 1.

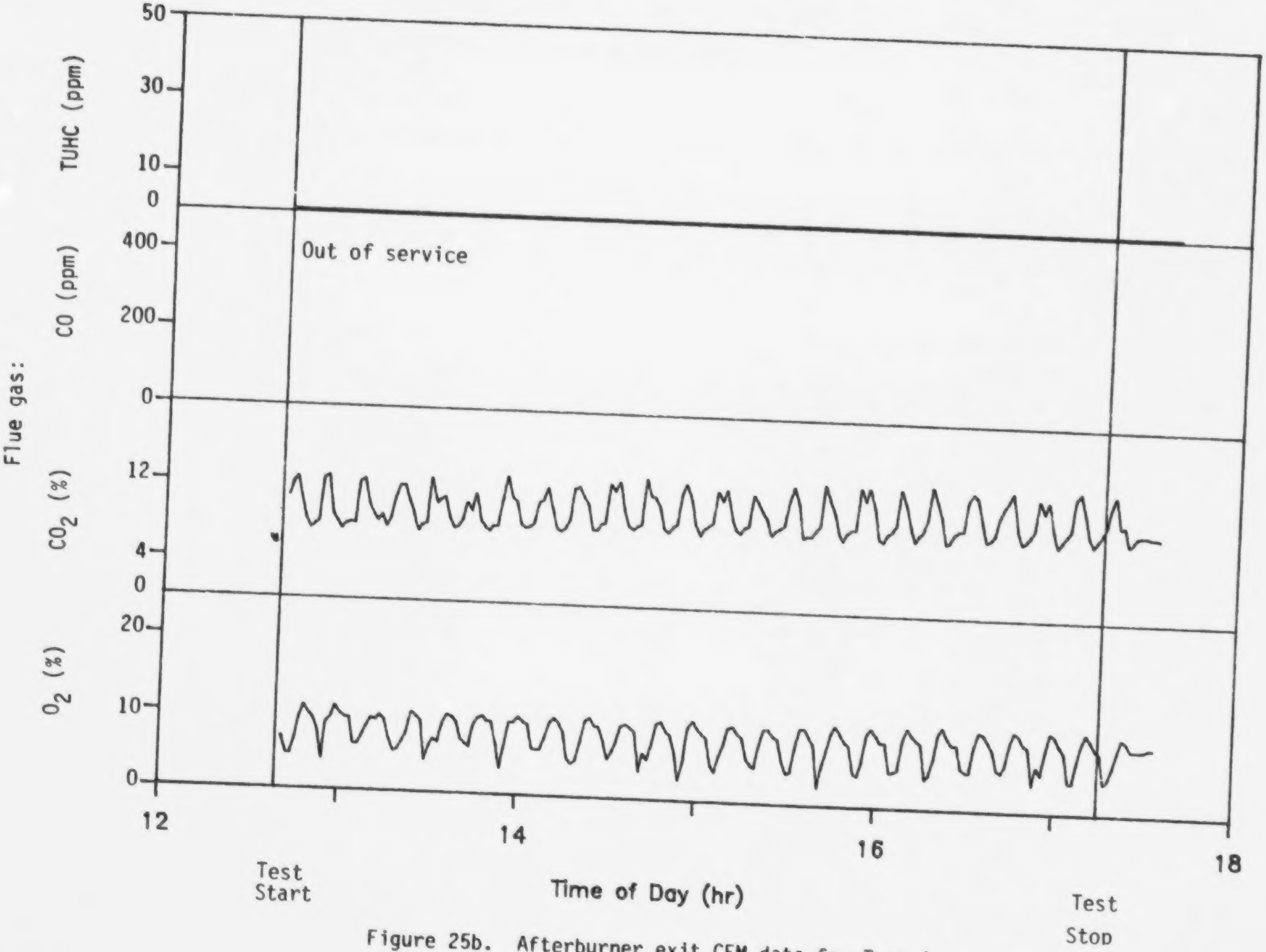

Figure 25b. Afterburner exit CEM data for Test 1.

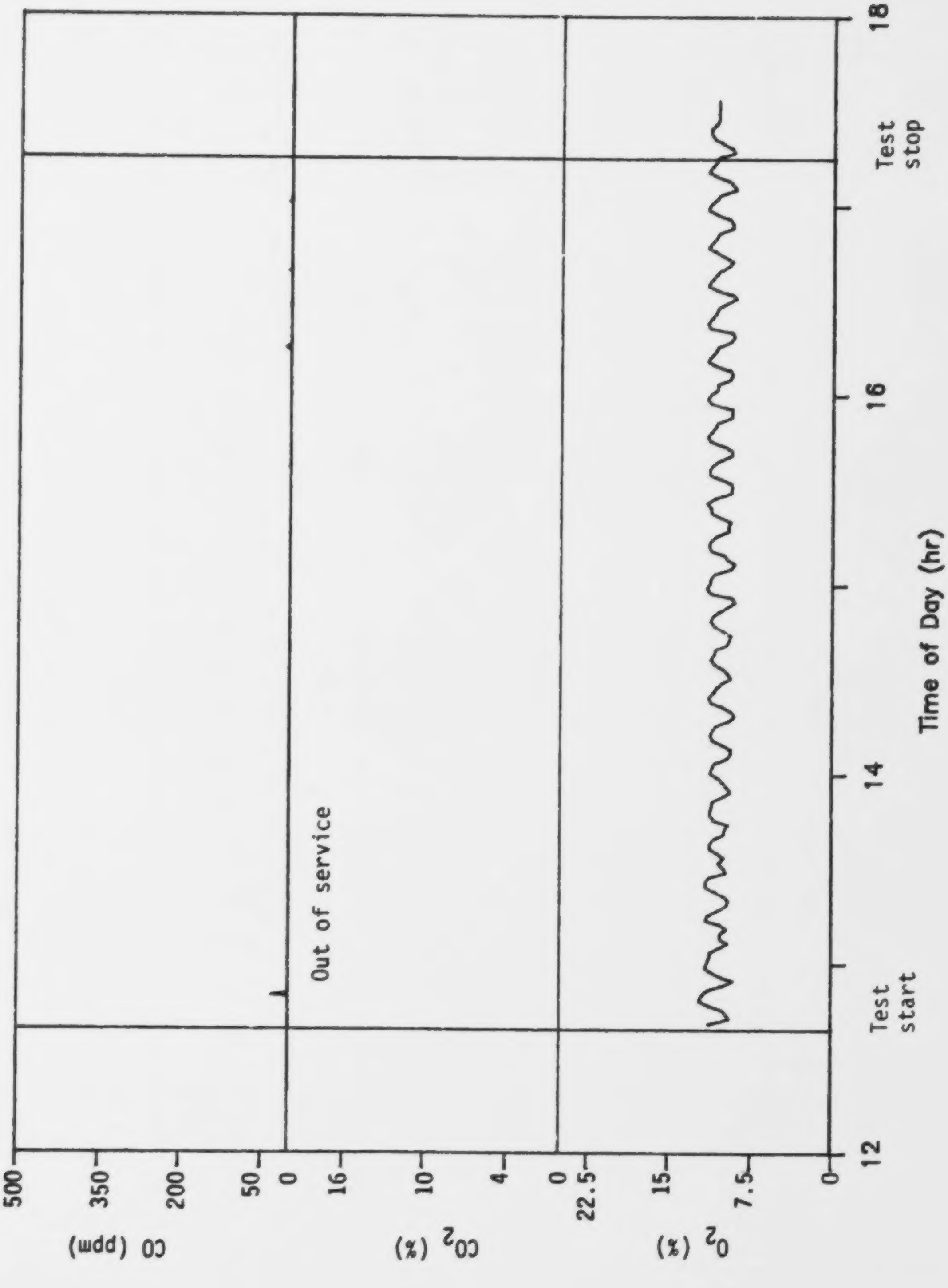

Figure 25c. Stack CEM data for Test 1.

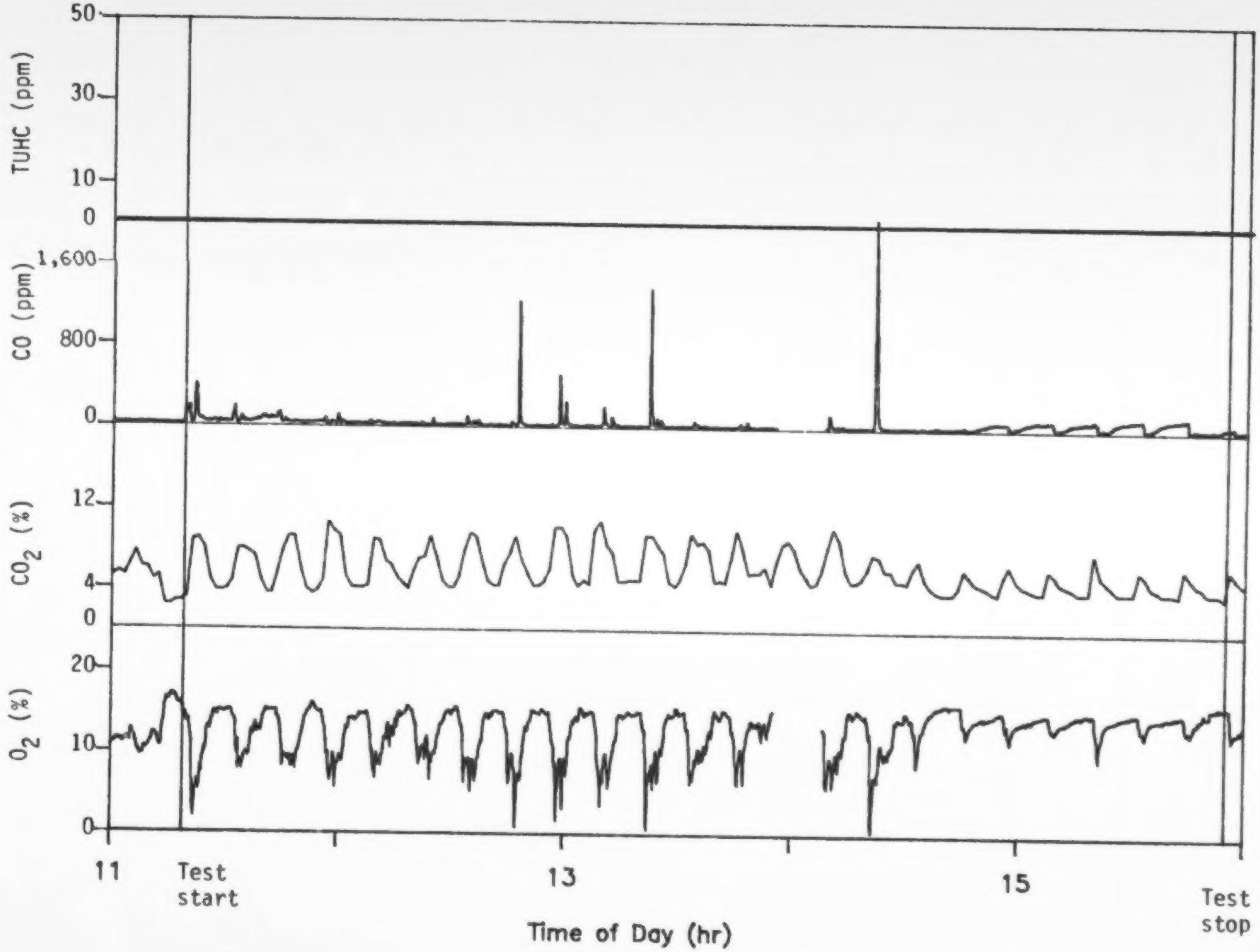

Figure 26a. Kiln exit CEM data for Test 2.

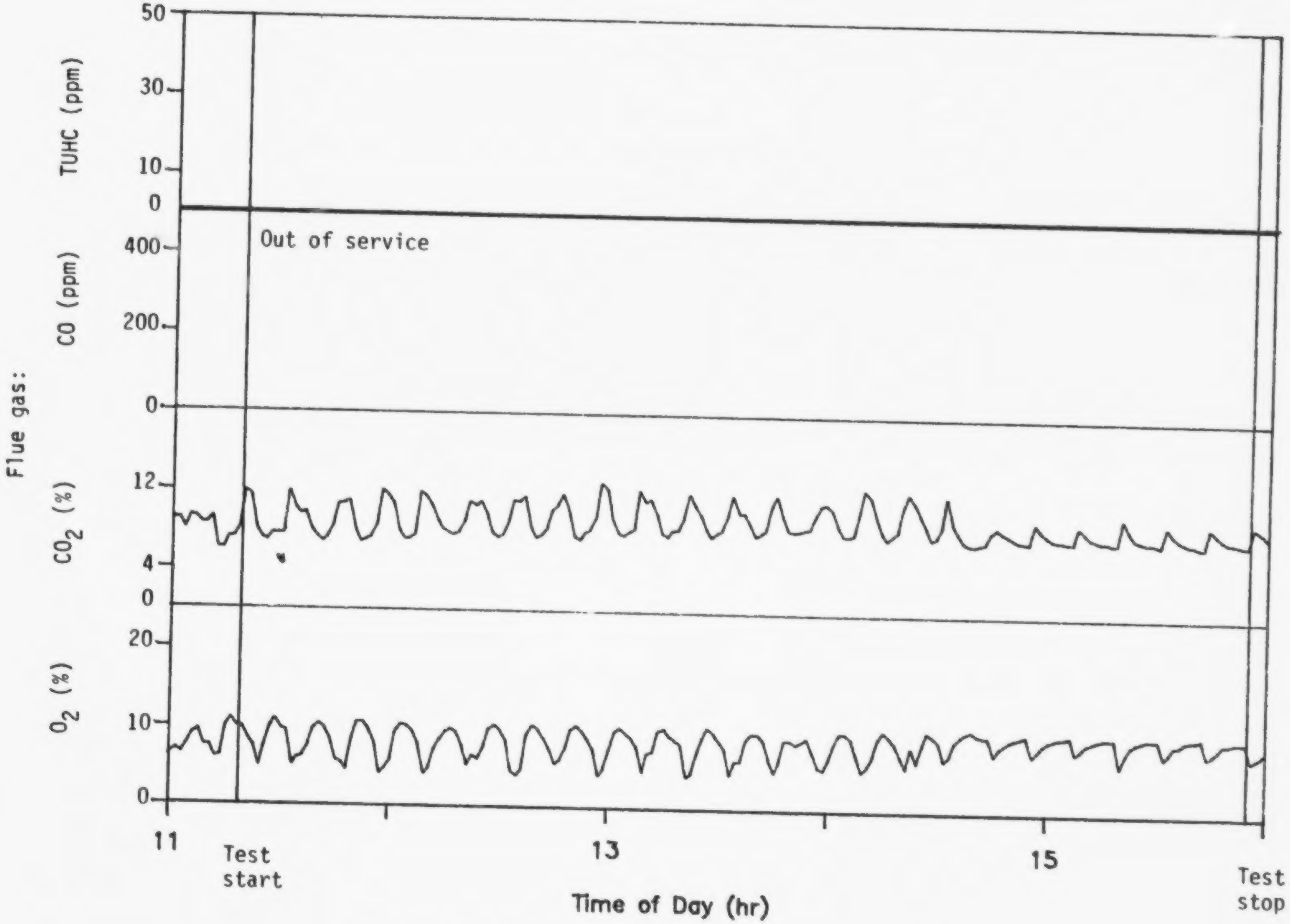

Figure 26b. Afterburner exit CEM data for Test 2.

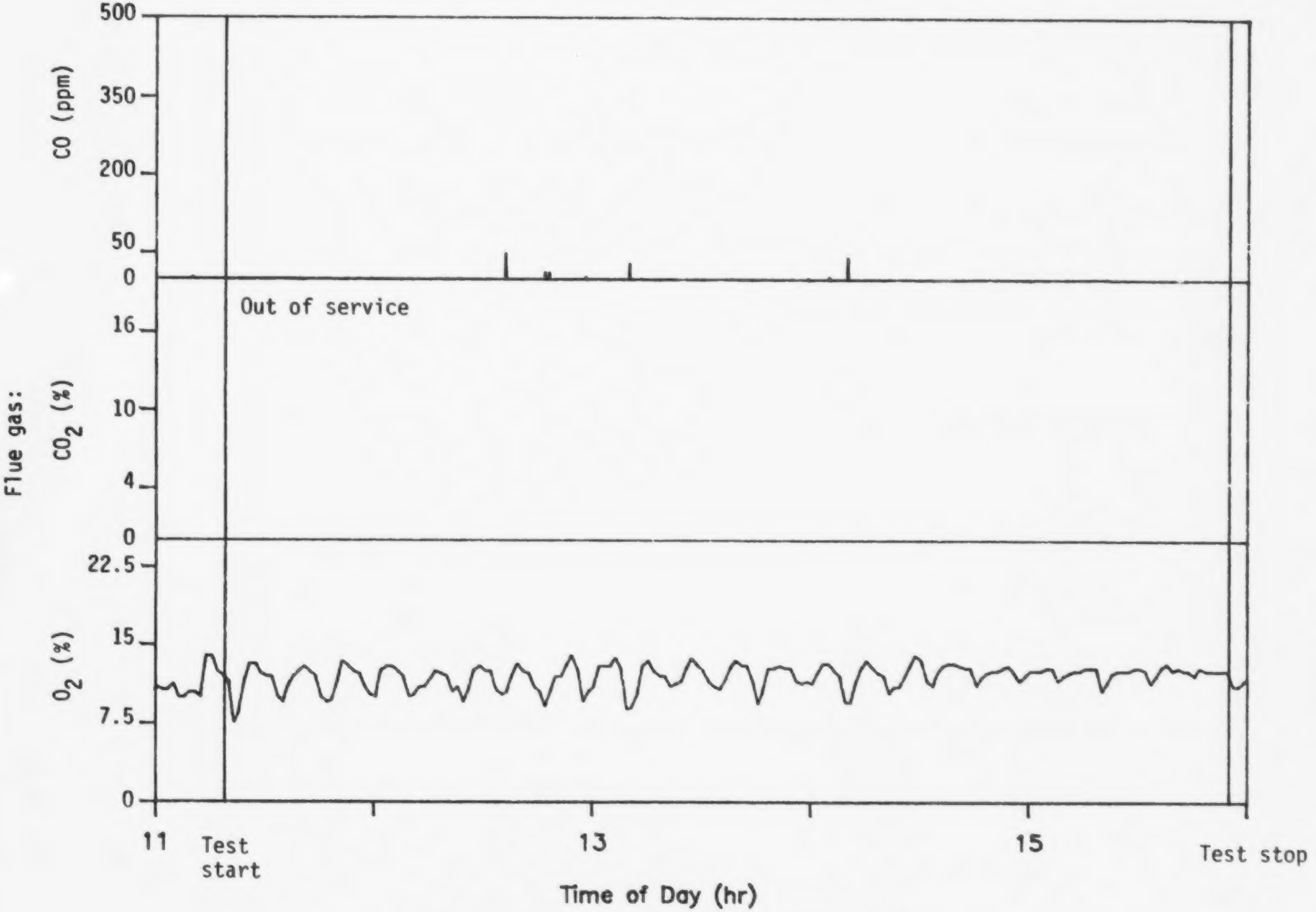

Figure 26c. Stack CEM data for the Test 2.

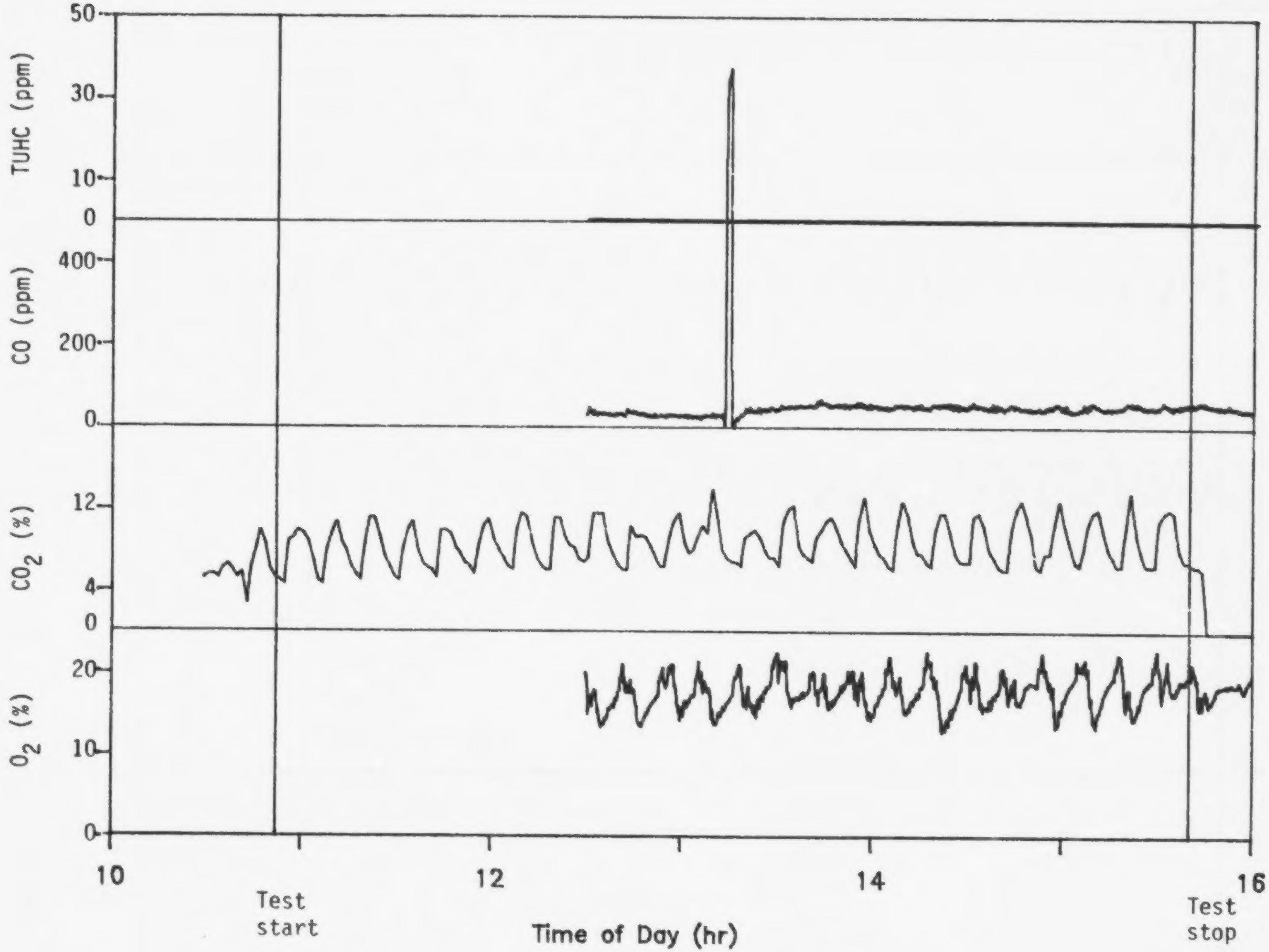

Figure 27a. Kiln exit CEM data for the Test 3.

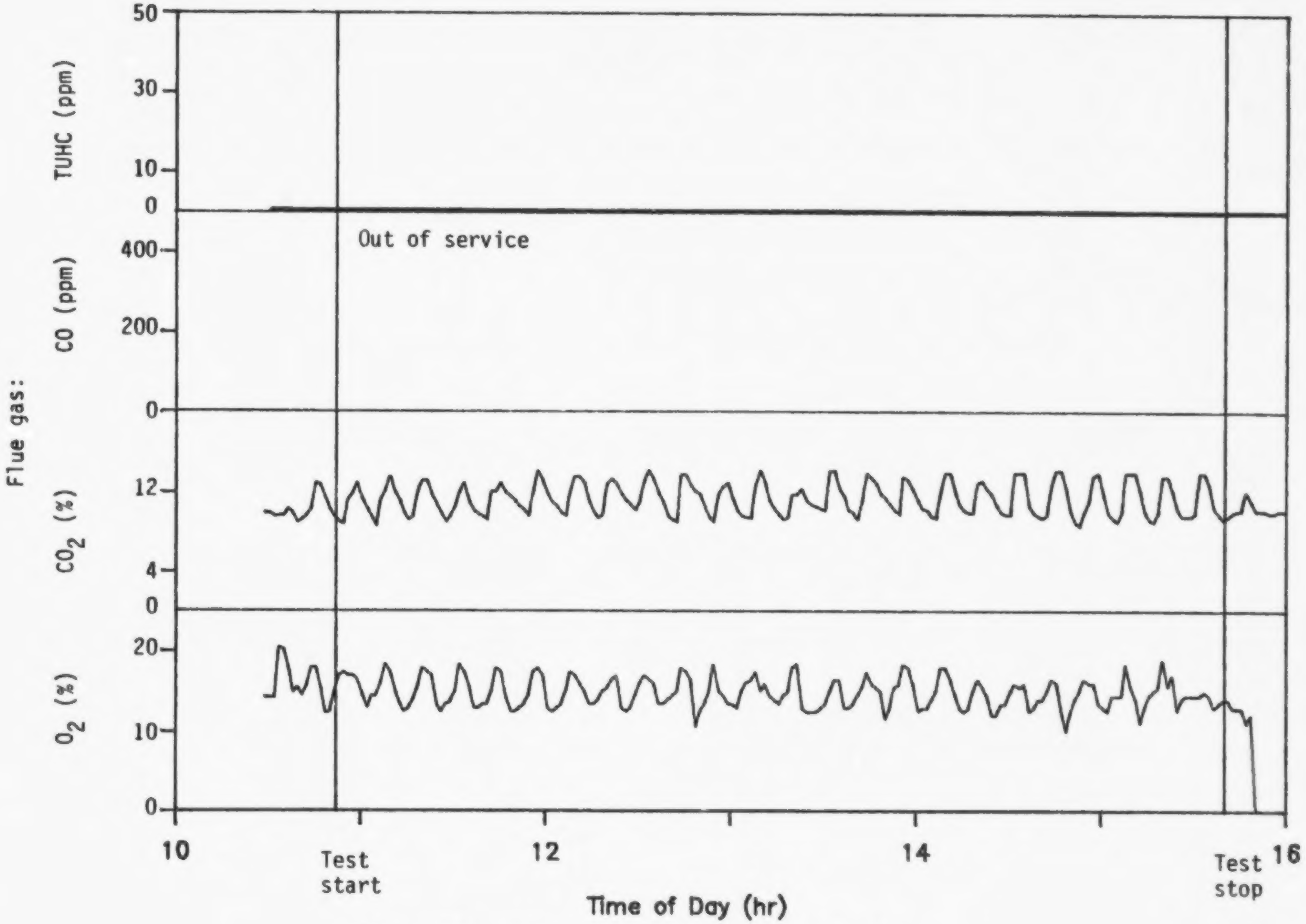

Figure 27b. Afterburner exit CEM data for Test 3.

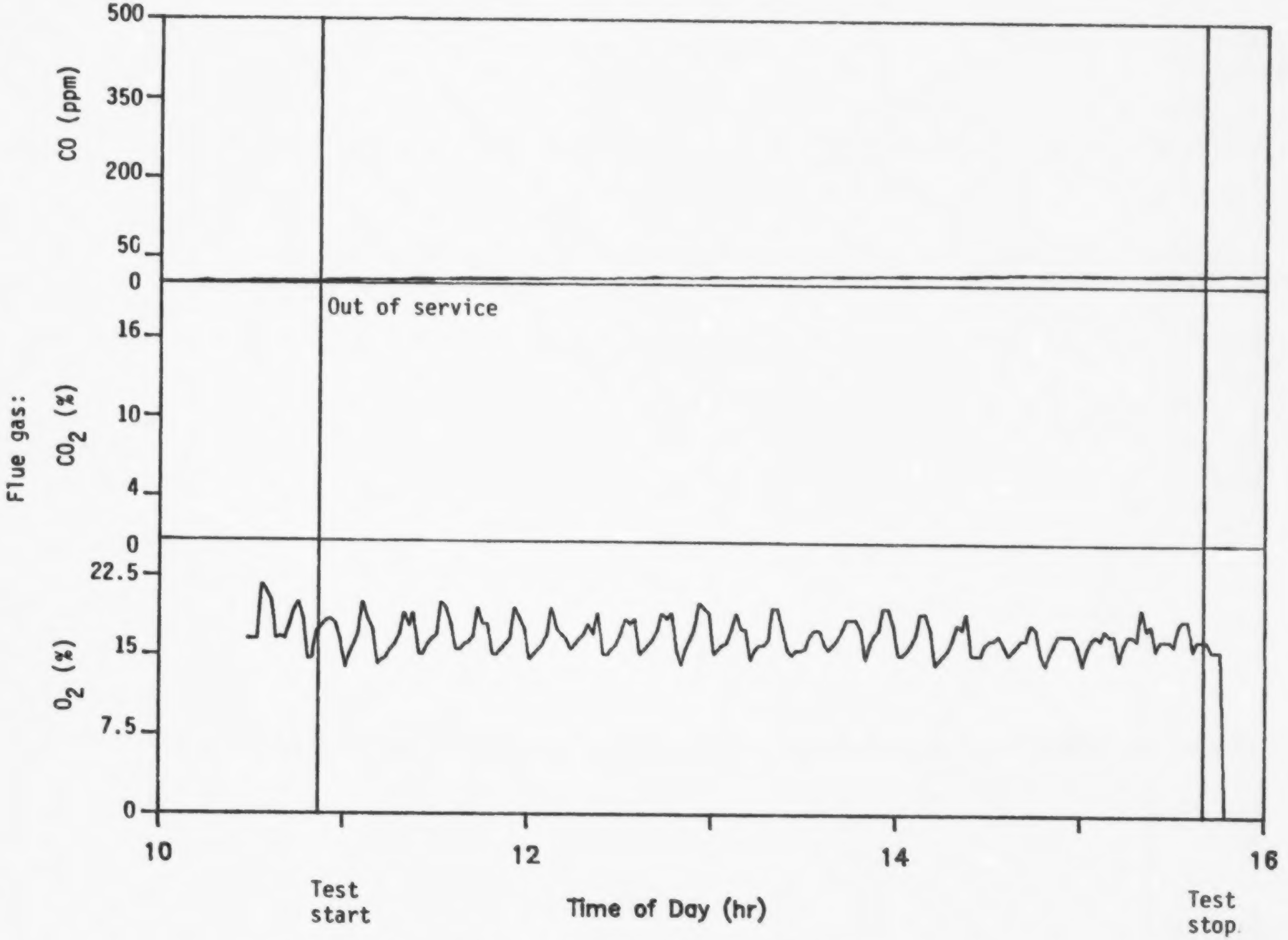

Figure 27c. Stack CEM data for Test 3.

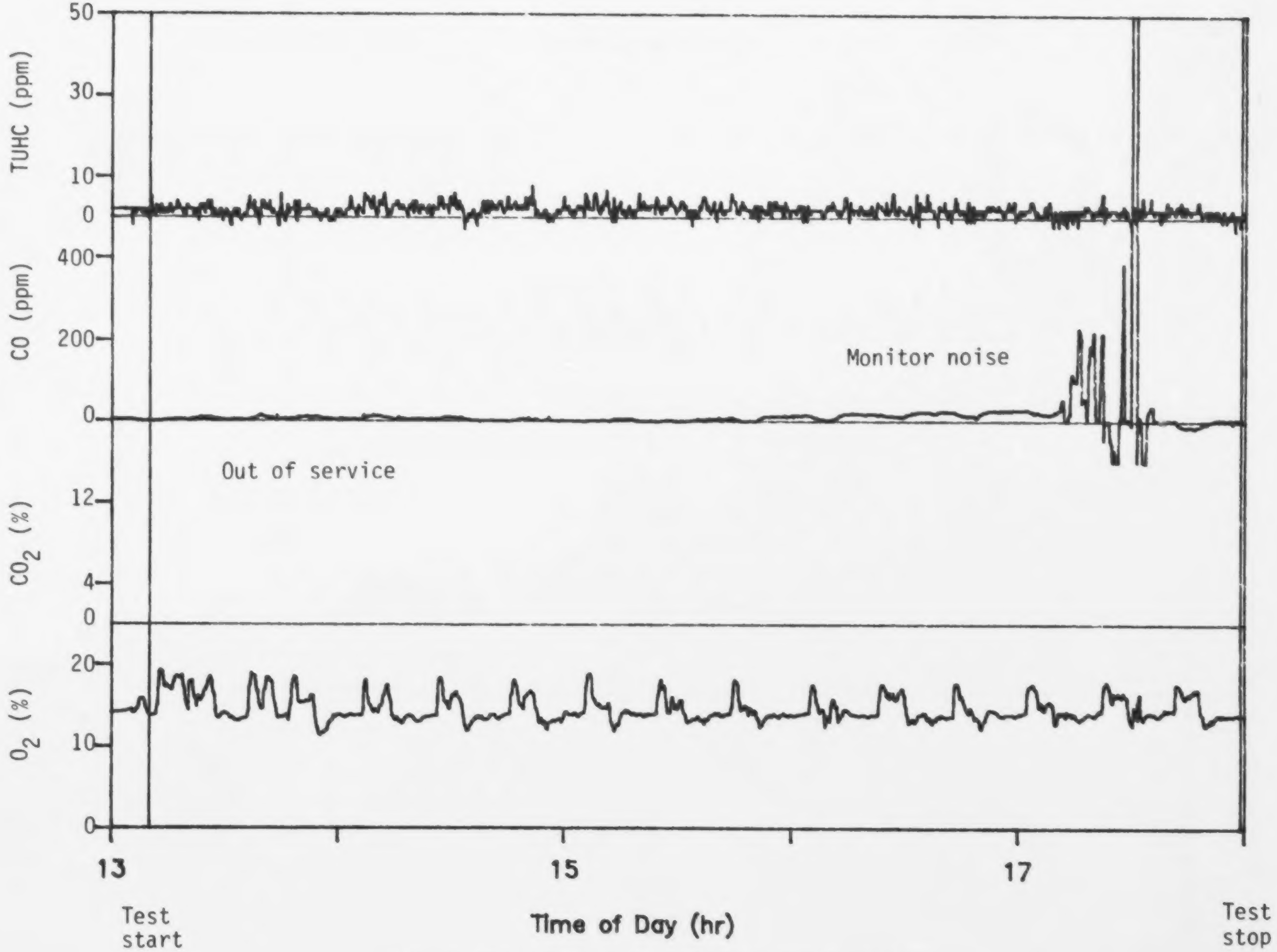

Figure 28a. Kiln exit CEM data for Test 4.

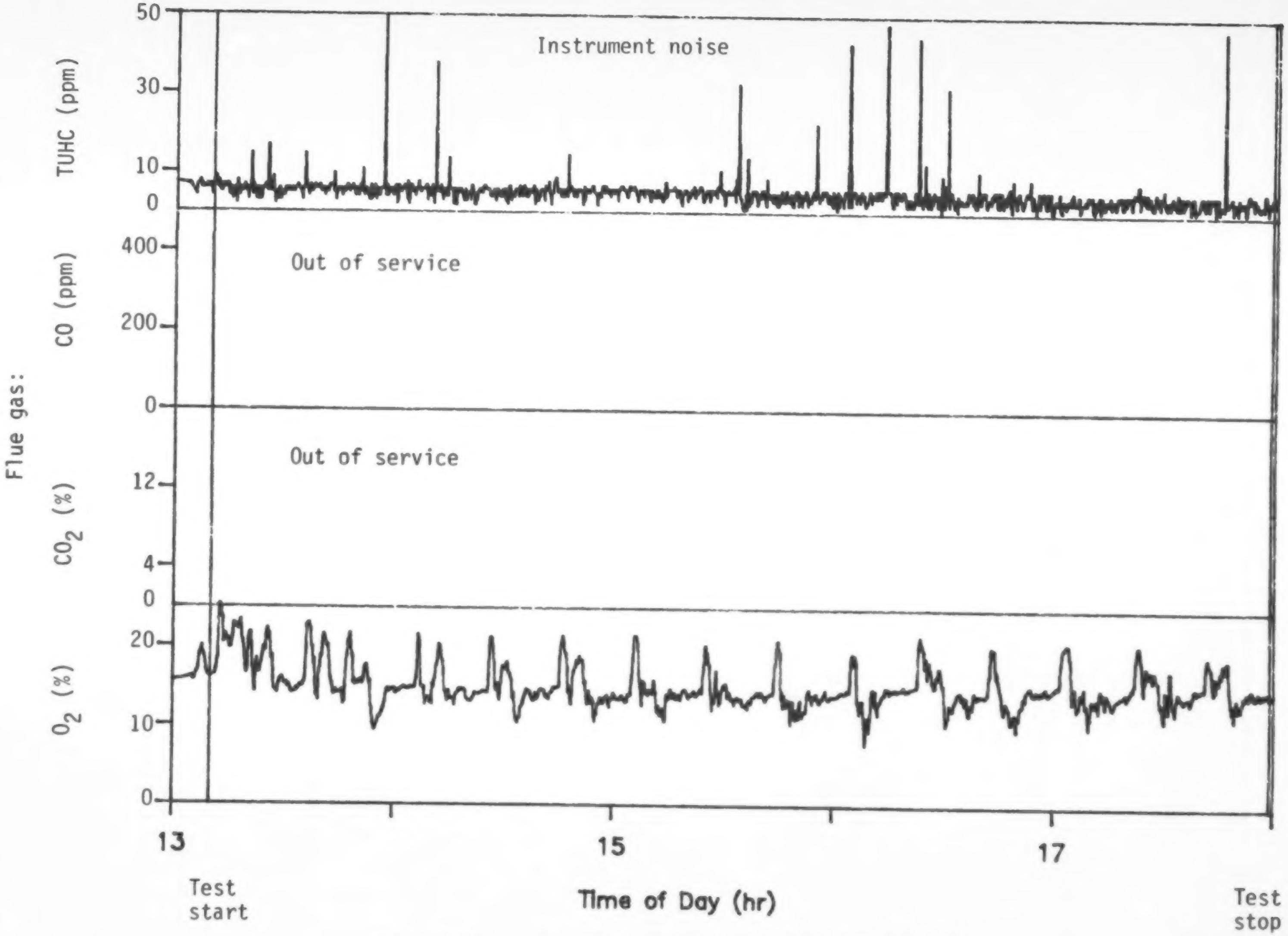

Figure 28b. Afterburner exit CEM data for Test 4.

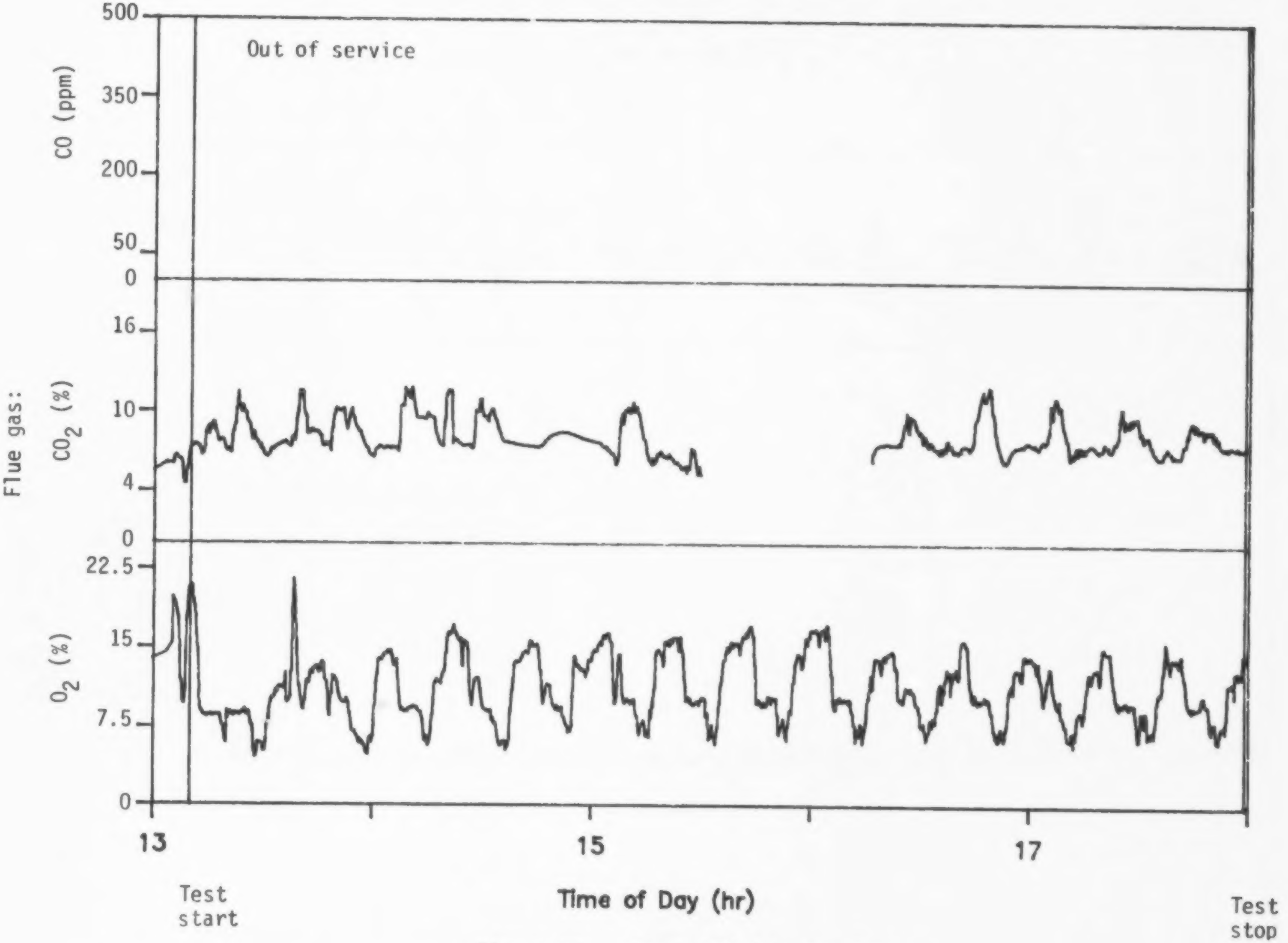

Figure 28c. Stack CEM data for Test 4.

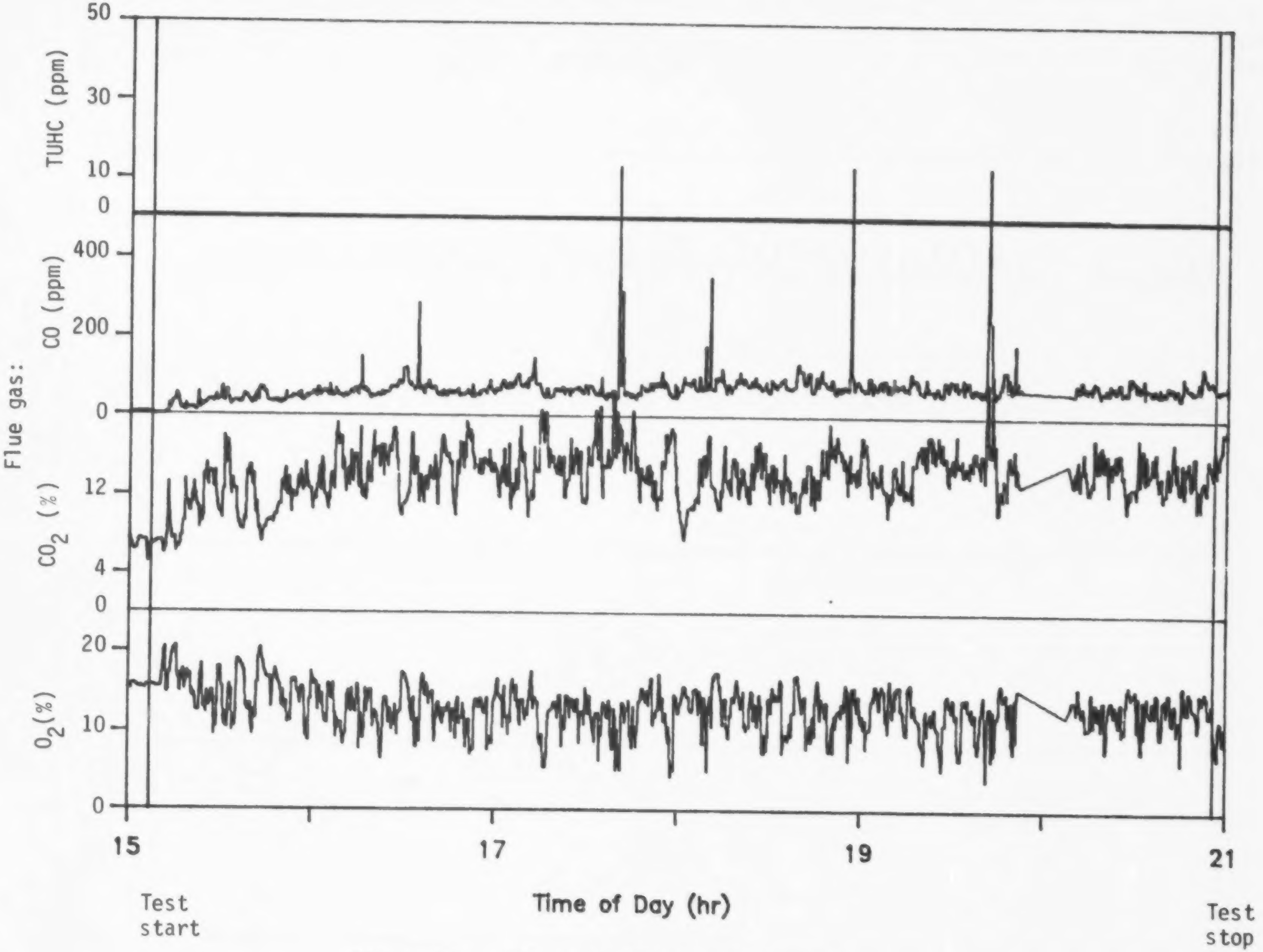

Figure 29a. Kiln exit CEM data for Test 5.

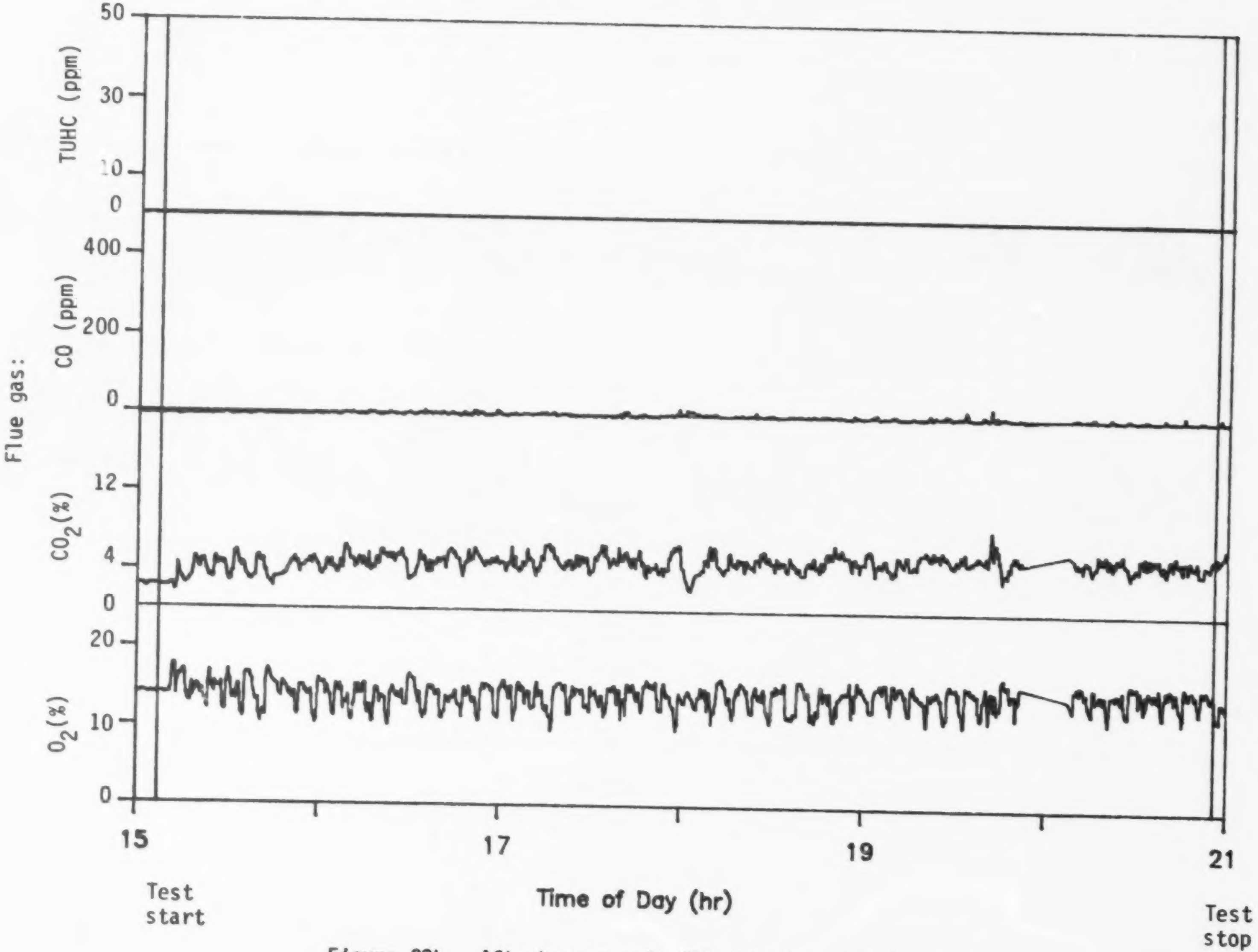

Figure 29b. Afterburner exit CEM data for Test 5.

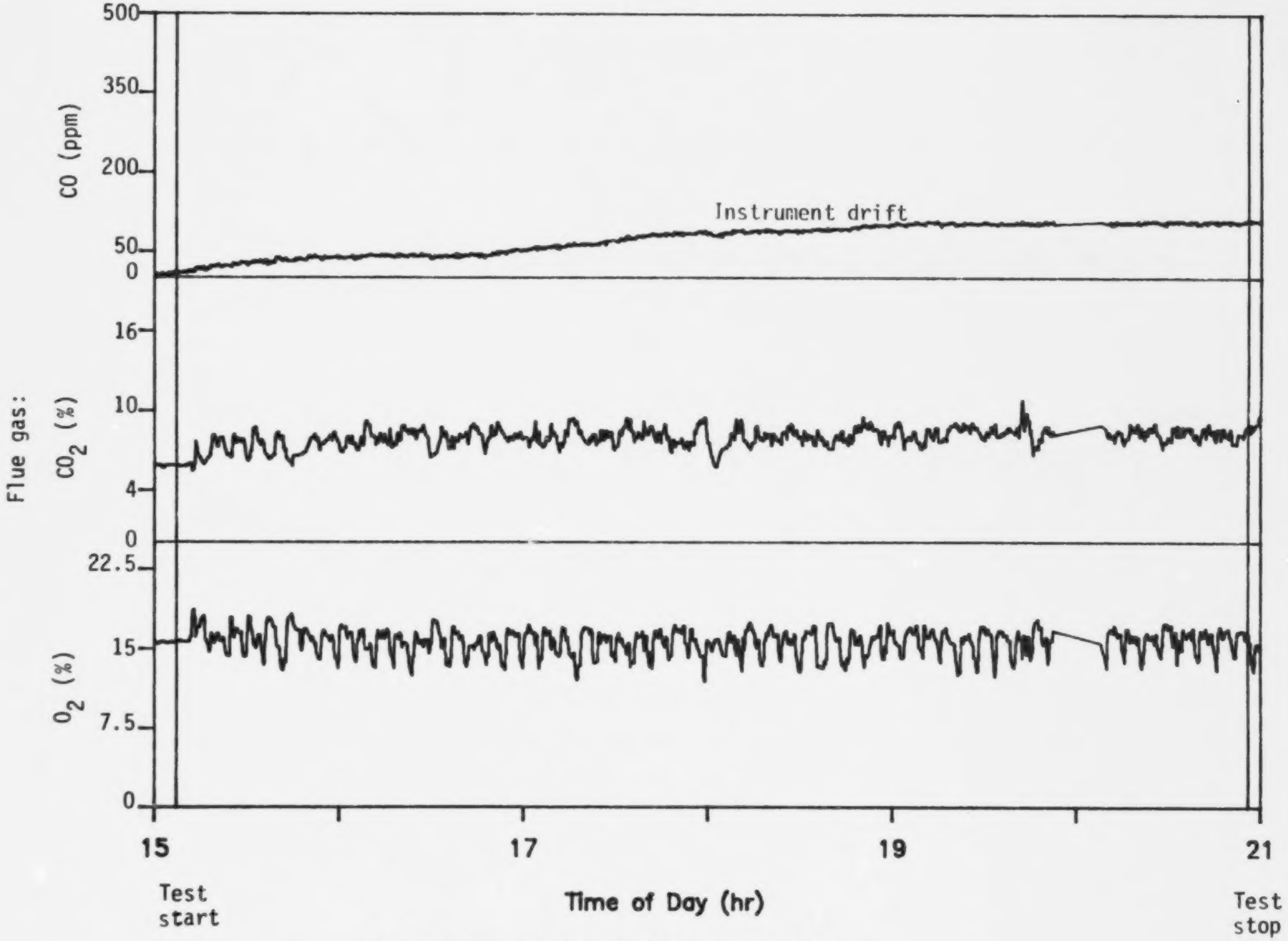

Figure 29c. Stack CEM data for Test 5.

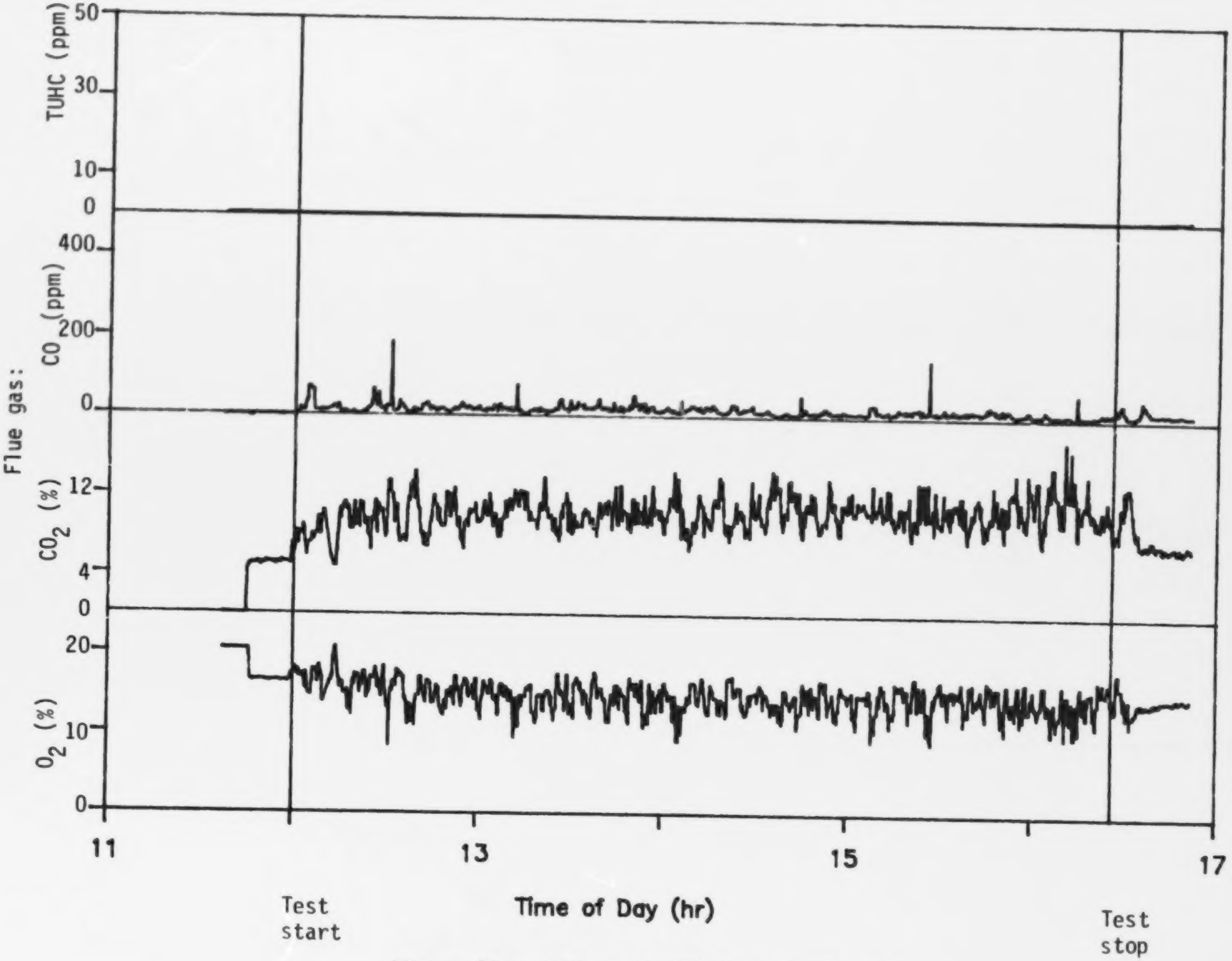

Figure 30a. Kiln exit CEM data for Test 6.

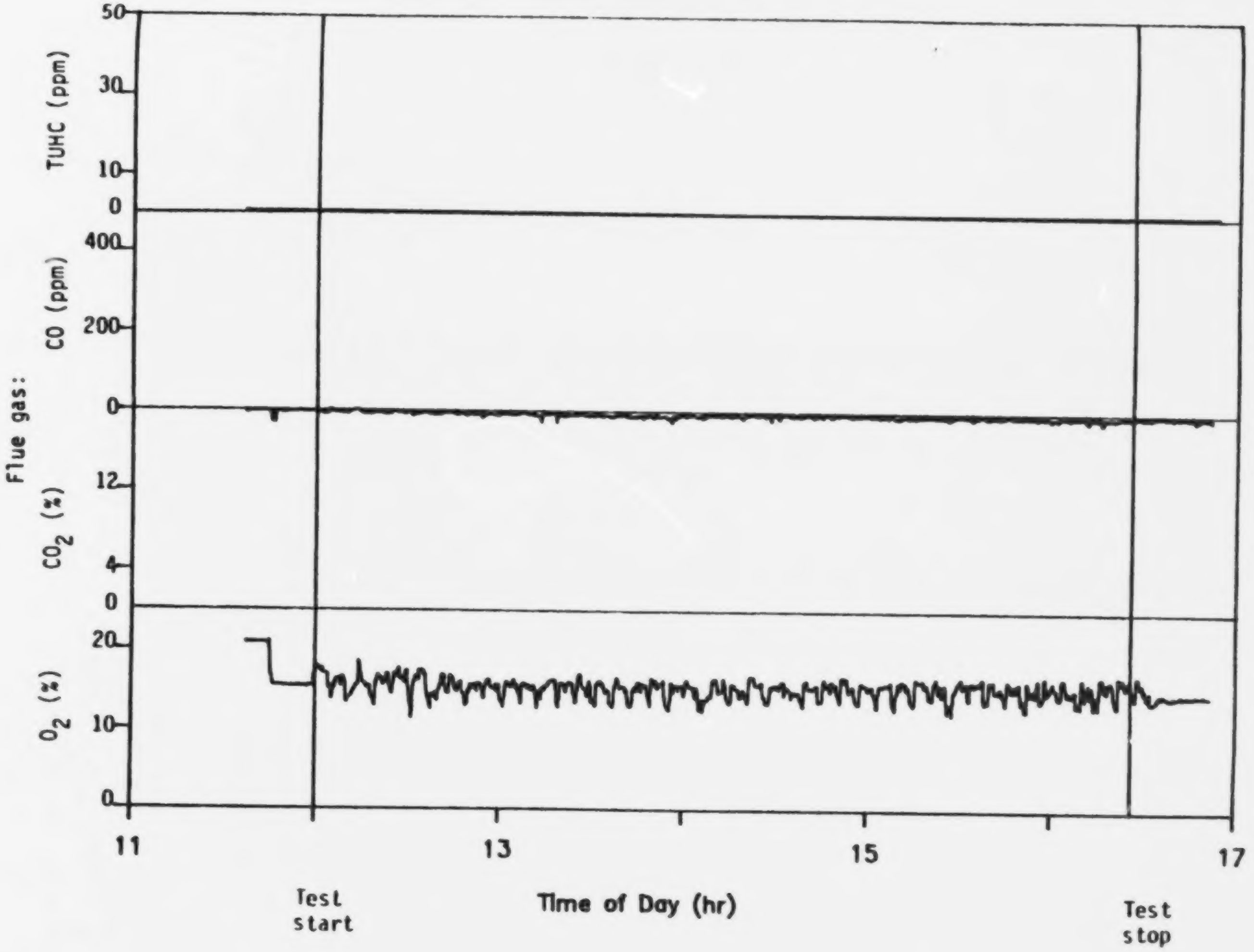

Figure 30b. Afterburner exit CEM data for Test 6.

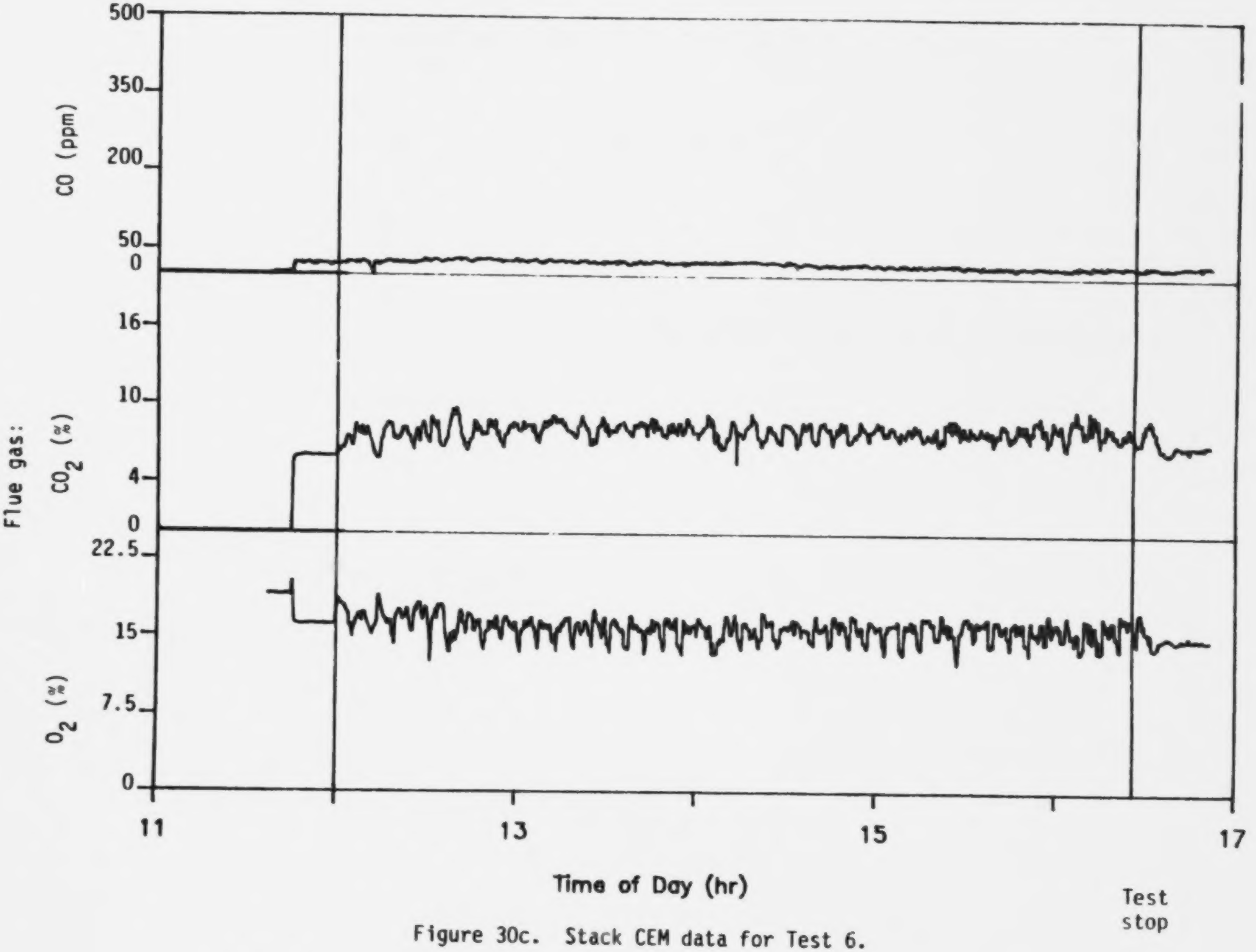

Figure 30c. Stack CEM data for Test 6.

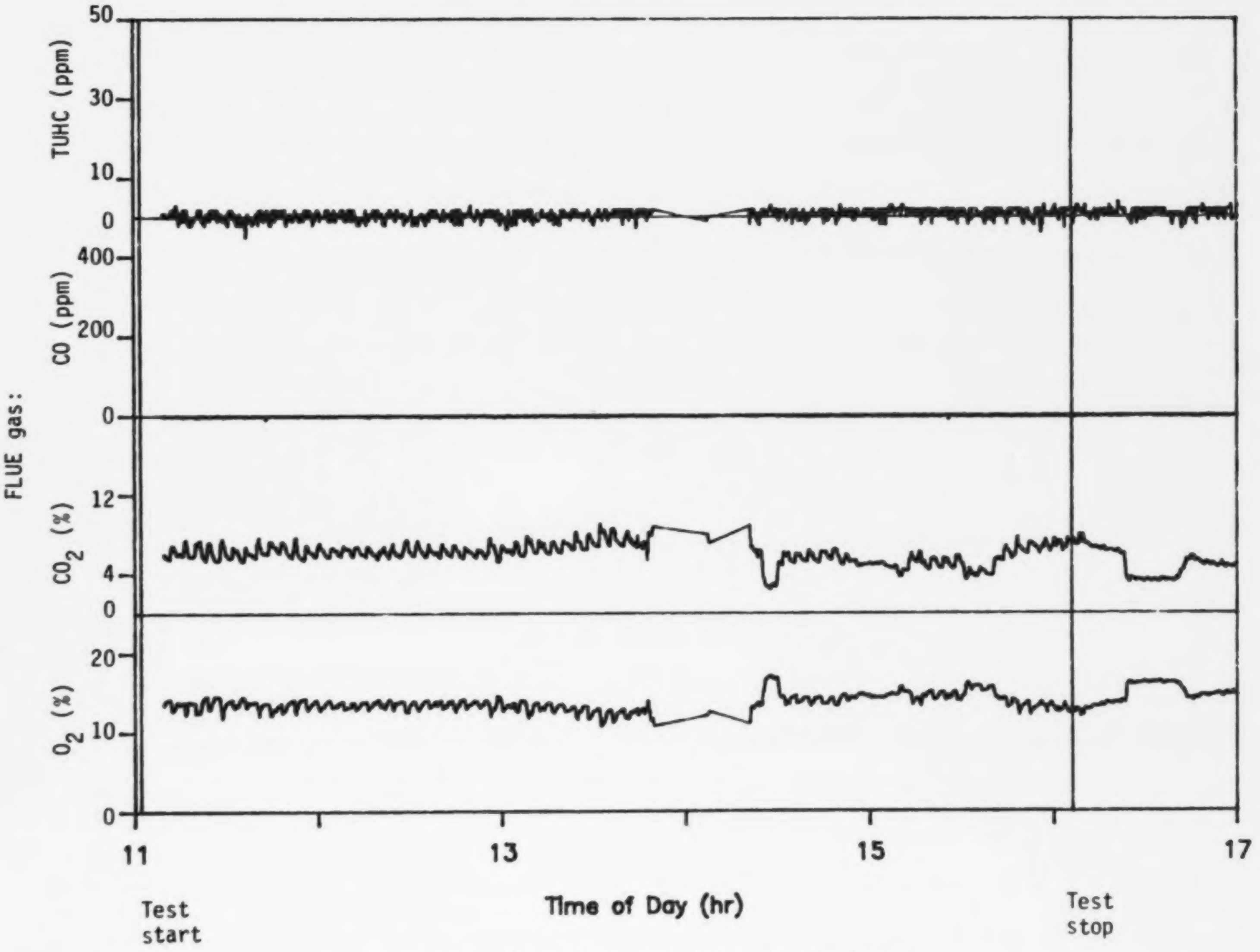

Figure 31a. Kiln exit CEM data for Test 7.

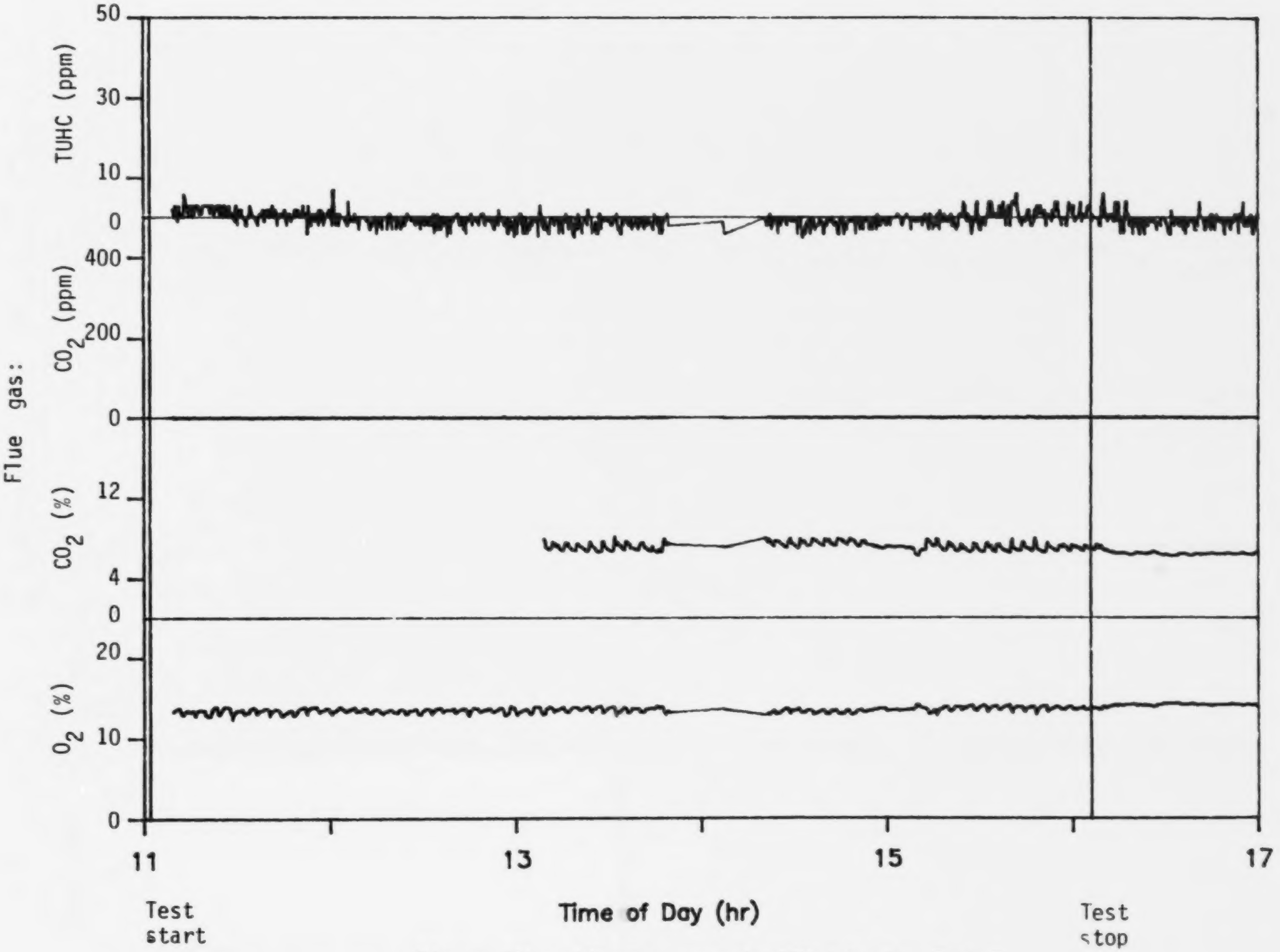

Figure 31b. Afterburner exit CEM data for Test 7.

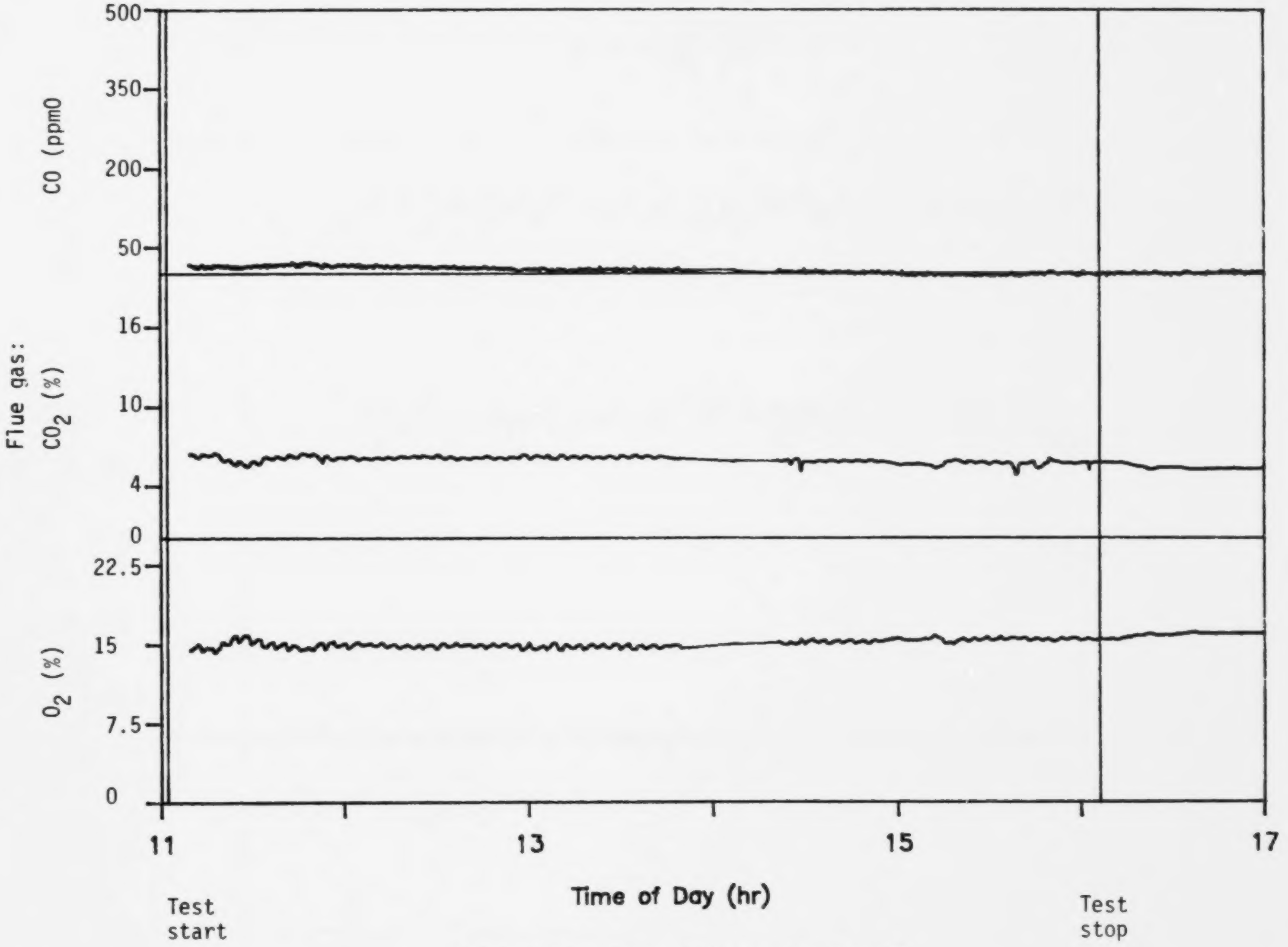

Figure 31c. Stack CEM data for Test 7.

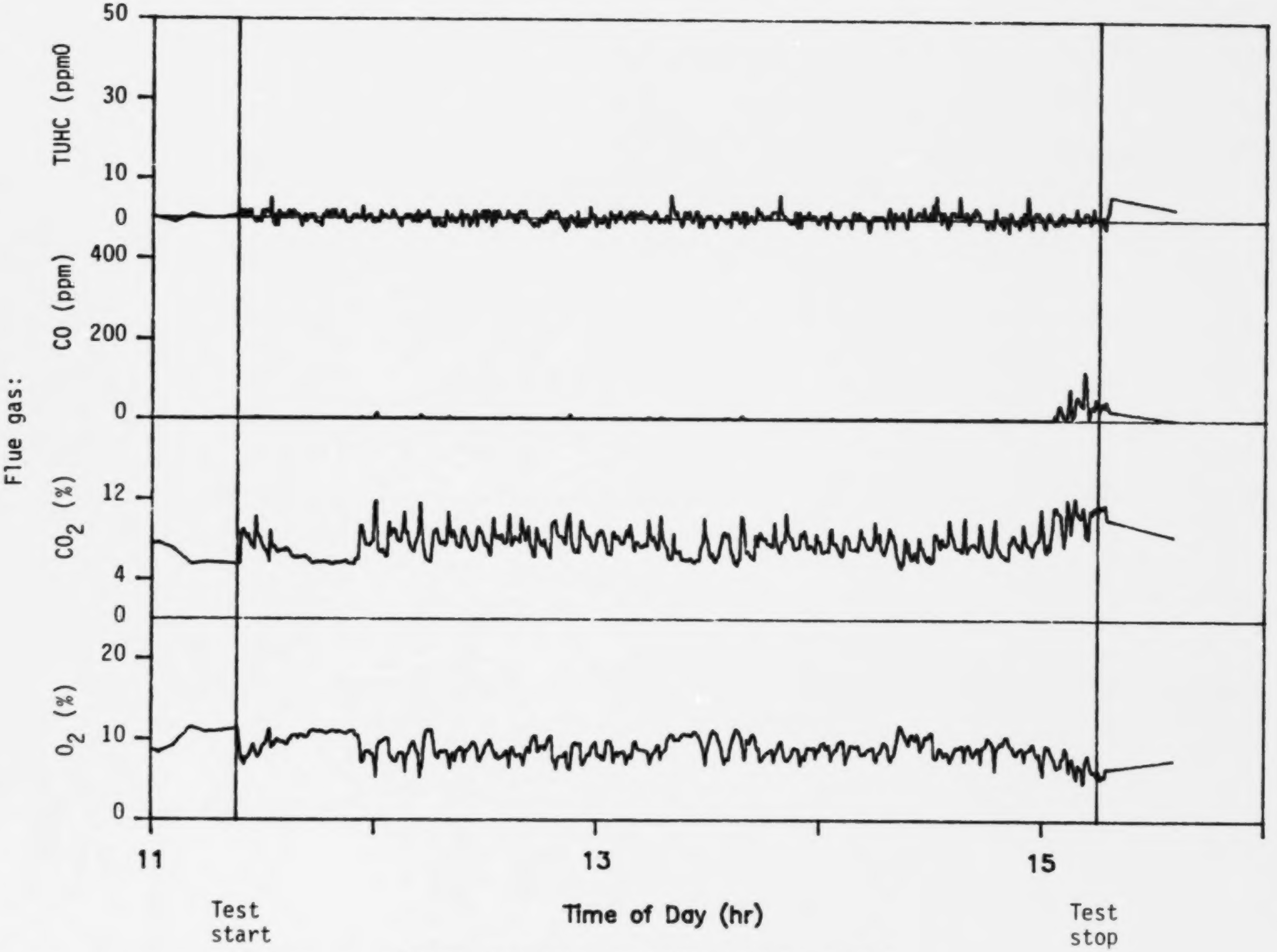

Figure 32a. Kiln exit CEM data for Test 8.

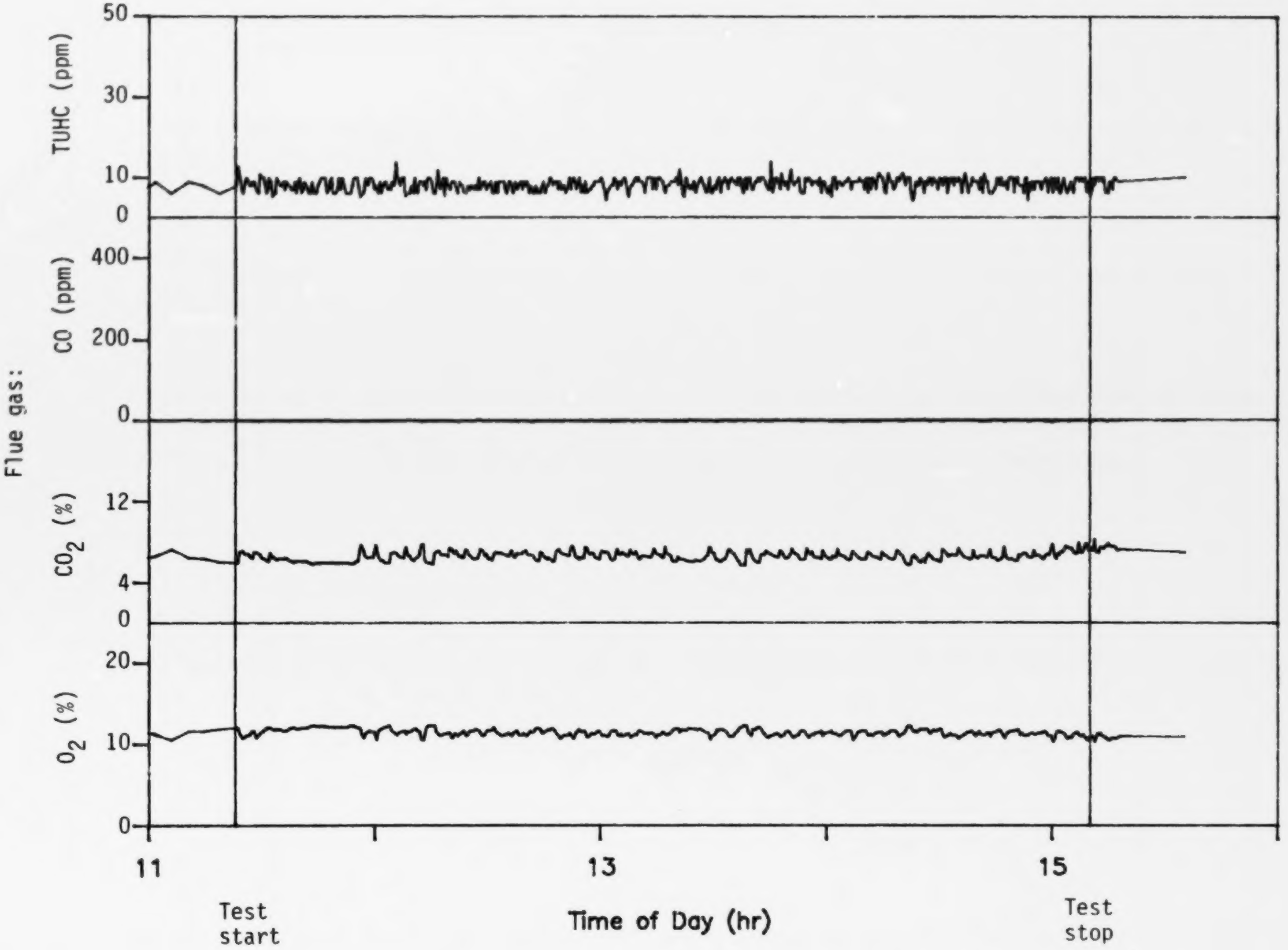

Figure 32b. Afterburner exit CEM data for Test 8.

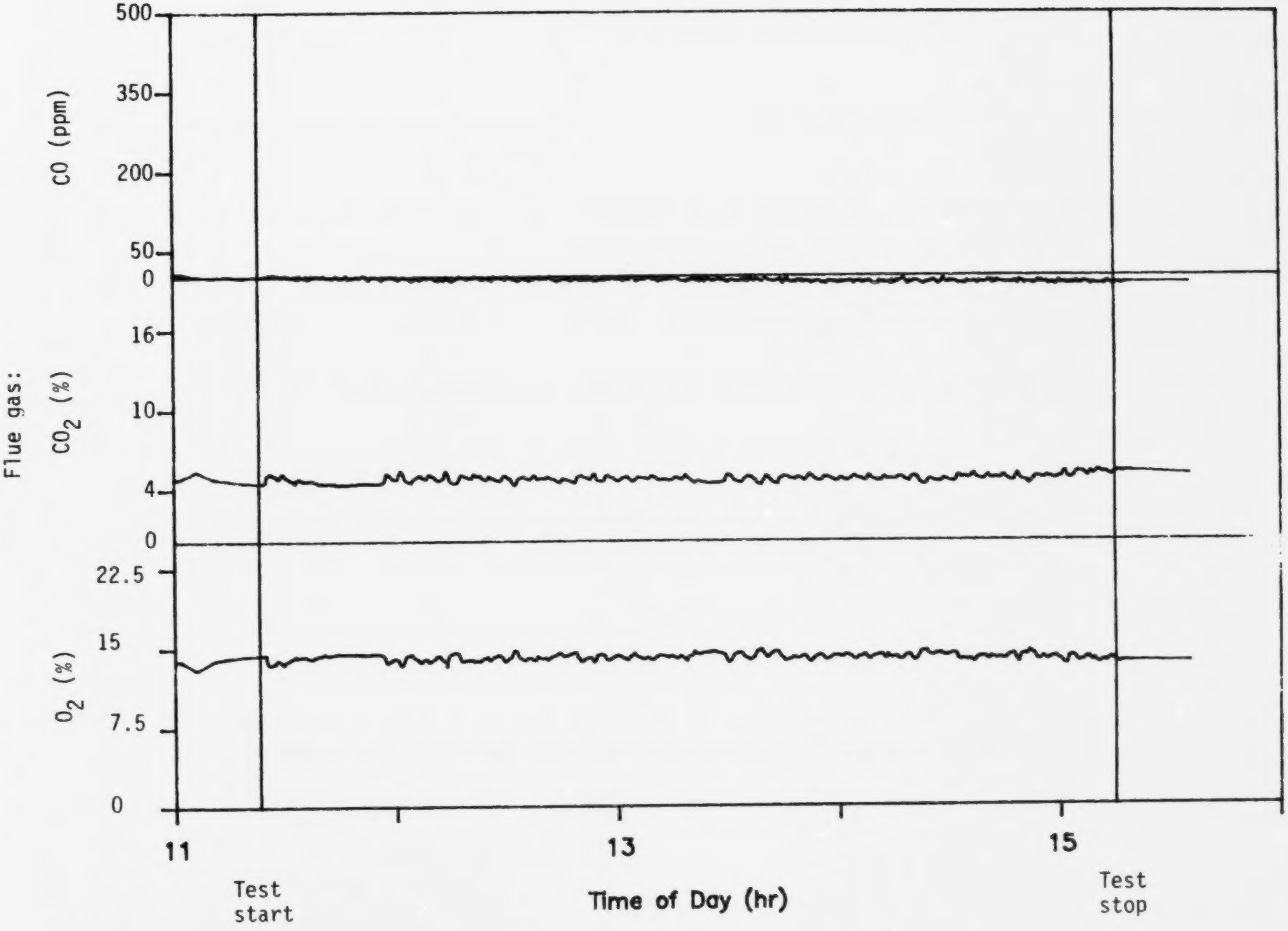

Figure 32c. Stack CEM data Test 8.

TABLE 11. ULTIMATE ANALYSIS OF COMPOSITE FEED SAMPLES

Parameter	Ultimate composition (wt percent as received) Tests 7 and 8 composite[a]	 Tests 1 through 6 composite[b]
C	0.5	69.3
H	1.2	4.0
O	2.9	2.9
N	0.01	0.8
S	0.1	0.5
Cl	0.2	0.03
Heating value MJ/kg (Btu/lb)	--	24.16 (10,410)

[a] Stringfellow soil.
[b] Stringfellow soil mixed with K087 waste.

TABLE 12. WASTE FEED COMPOSITION

Compound	Feed concentration (mg/g)							
	Test 1 (12-9-87)	Test 2 (12-11-87)	Test 3 (12-17-87)	Test 4 (1-14-88)	Test 5 (1-20-88)	Test 6 (1-21-88)	Test 7 (1-27-88)	Test 8 (1-29-88)
POHCs								
Naphthalene	60	48	34	68	63	100	<0.33	<0.33
Acenaphthylene	16	11	7.8	16	16	24	<0.33	<0.33
Fluorene	7.2	5.4	5.6	7.9	7.7	12	<0.33	<0.33
Phenanthrene	27	22	17	28	28	43	<0.33	<0.33
Anthracene	8.1	6.6	5.3	8.5	8.5	13	<0.33	<0.33
Fluoranthene	19	14	8.9	13	13	18	<0.33	<0.33
Hexachloroethane	<6.6	<5.0	<2.9	<5.0	<5.0	<10	3.5	4.0
1,3,5-Trichlorobenzene	<6.6	<5.0	<2.9	<5.0	<5.0	<10	2.2	2.2
Other semivolatile organic hazardous constituents								
Pyrene	15	11	9.8	12	12	23	<0.33	<0.33
Benzo(a)anthracene	<6.6	<5.0	3.8	5.8	5.8	<10	<0.33	<0.33
Chrysene	<6.6	<5.0	3.9	6.1	5.7	<10	<0.33	<0.33
Benzo(b)fluoranthene	<6.6	<5.0	3.7	6.6	<5.0	11	<0.33	<0.33
Indeno(1,2,3-cd)pyrene	<6.6	<5.0	<2.9	22	<5.0	29	<0.33	<0.33
Nitrophenols and pentachlorophenol	<32	<25	<14	<25	<25	<50	<1.7	<1.7
All others	<6.6	<5.0	<2.9	<5.0	<5.0	<10	<0.33	<0.33
Other semivolatile organic compounds								
2-Methylnapthalene	4.8	4.0	4.3	5.2	5.0	7.9	<0.33	<0.33
Dibenzofuran	5.8	4.7	4.4	5.8	5.8	8.9	<0.33	<0.33
Total waste feed, kg(lb)								
Scrubber discharge sampling period	185 (407)	160 (353)	181 (398)	188 (414)	516 (1,135)	359 (751)	209 (459)	130 (287)
Stack discharge sampling period	-- --	179 (395)	181 (398)	188 (414)	433 (952)	-- --	223 (490)	138 (305)

TABLE 13. SEMIVOLATILE ORGANIC CONSTITUENTS IN SCRUBBER DISCHARGE MM5 TRAIN SAMPLES

Constituent	Concentration (μg/train)											
	Test 1 (12-9-87)		Test 2 (12-11-87)		Test 3 (12-17-87)	Test 4 (1-14-88)	Test 5 (1-20-88)		Test 6 (1-21-88)		Test 7 (1-27-88)	Test 8 (1-29-88)
	Train 1	Train 2	Train 1	Train 2			Train 1	Train 2	Train 1	Train 2		
POHCs												
Naphthalene	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
Acenaphthylene	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
Fluorene	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
Phenanthrene	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
Anthracene	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
Fluoranthene	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
Hexachloroethane	<40	<40	<40	<200	<40	<20	<31[a]	110[a]	<20	<20	25	<20
1,3,5-Trichlorobenzene	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
Other semivolatile hazardous constituents												
Butylbenzylphthalate	<40	<40	<40	<200	<40	37	<20	<20	<20	<20	<20	<20
Bis(2-ethylhexyl)phthalate	120	680	<40	2,600	120	910	330	39	120	290	780	<20
Di-n-octyl phthalate	<40	54	<40	<200	88	30	22	<20	31	39	<20	<20
2,4-Dichlorophenol	<40	<40	<40	<200	<40	<20	<20	<20	29	<20	<20	<20
Nitrophenols and pentachlorophenol	<200	<200	<200	<1,000	<200	<100	<100	<100	<100	<100	<100	<100
All others	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20

[a] Not a POHC for this test.

TABLE 16. SCRUBBER DISCHARGE FLUE GAS POHC EMISSION RATES

Parameter	Test 1 (12-9-87)		Test 2 (12-11-87)		Test 3 (12-17-87)	Test 4 (1-14-88)	Test 5 (1-20-88)		Test 6 (1-21-88)		Test 7 (1-27-88)	Test 8 (1-29-88)
	Train 1	Train 2	Train 1	Train 2			Train 1	Train 2	Train 1	Train 2		
Flue gas volume sampled (dscm)	4.56	4.74	4.28	4.16	4.01	4.67	4.69	5.07	4.64	4.17	5.02	4.55
POHC concentration												
Hexachloroethane												
(μg/train)	--	--	--	--	--	--	31	110	--	--	25	<20
(μg/dscm)	--	--	--	--	--	--	6.6	22	--	--	5.0	<4.4
All others												
(μg/train)	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
(μg/dscm)	<8.8	<8.4	<9.4	<48	<10	<4.3	<4.3	<3.9	<4.3	<4.8	<4.0	<4.4
Flue gas flowrate (dscm/min)	33.4		28.7		26.4	26.1	24.6		31.0		29.9	37.6
POHC emission rate (mg/hr)												
Hexachloroethane	--	--	--	--	--	--	9.8	32	--	--	8.9	<9.9
All others	<18	<17	<16	<76	<16	<6.7	<6.3	<5.8	<7.8	<8.7	<7.1	<9.9
Sampling period (hr)	4.15		3.63		4.08	4.07	5.45		3.83		4.28	2.90
Sampling period emissions (mg)												
Hexachloroethane	--	--	--	--	--	--	53	170	--	--	38	<29
All others	<73	<70	<58	<280	<64	<27	<34	<32	<30	<33	<31	<29

TABLE 13. SEMIVOLATILE ORGANIC CONSTITUENTS IN SCRUBBER DISCHARGE MM5 TRAIN SAMPLES

	Concentration (μg/train)											
	Test 1 (12-9-87)		Test 2 (12-11-87)		Test 3 (12-17-87)	Test 4 (1-14-88)	Test 5 (1-20-88)		Test 6 (1-21-88)		Test 7 (1-27-88)	Test 8 (1-29-88)
Constituent	Train 1	Train 2	Train 1	Train 2			Train 1	Train 2	Train 1	Train 2		
POHCs												
Naphthalene	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
Acenaphthylene	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
Fluorene	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
Phenanthrene	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
Anthracene	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
Fluoranthene	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
Hexachloroethane	<40	<40	<40	<200	<40	<20	<31[a]	110[a]	<20	<20	25	<20
1,3,5-Trichlorobenzene	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
Other semivolatile hazardous constituents												
Butylbenzylphthalate	<40	<40	<40	<200	<40	37	<20	<20	<20	<20	<20	<20
Bis(2-ethylhexyl)phthalate	120	680	<40	2,600	120	910	330	39	120	290	780	<20
Di-n-octyl phthalate	<40	54	<40	<200	88	30	22	<20	31	39	<20	<20
2,4-Dichlorophenol	<40	<40	<40	<200	<40	<20	<20	<20	29	<20	<20	<20
Nitrophenols and pentachlorophenol	<200	<200	<200	<1,000	<200	<100	<100	<100	<100	<100	<100	<100
All others	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20

[a] Not a POHC for this test.

TABLE 14. SEMIVOLATILE ORGANIC HAZARDOUS CONSITITUENTS IN STACK GAS MM5 TRAIN SAMPLES

Constituent	Concentration (μg/train)					
	Test 2 (12-11-87)	Test 3 (12-17-87)	Test 4 (1-14-88)	Test 5 (1-20-88)	Test 6 (1-27-88)	Test 8 (1-29-88)
POHCs						
Naphthalene	<40	<40	--[a]	<20	<20	<20
Acenaphthylene	<40	<40	--	<20	<20	<20
Fluorene	<40	<40	--	<20	<20	<20
Phenanthrene	<40	<40	--	<20	<20	<20
Anthracene	<40	<40	--	<20	<20	<20
Fluoranthene	<40	<40	--	<20	<20	<20
Hexachloroethane	<40	<40	--	220[b]	77	<20
1,3,5-Trichlorobenzene	<40	<40	--	<20	<20	<20
Other semivolatile hazardous constituents						
Butylbenzylphthalate	<40	<40	--	<27	<20	<20
Bis(2-ethylhexyl)phthalate	80	120	--	290	<20	2,000
Di-n-octyl phthalate	<40	<40	--	36	28	20
2,4-Dichlorophenol	<40	<40	--	<20	<20	<20
Nitrophenols and pentachlorophenol	<200	<200	--	<100	<100	<100
All others	<40	<40	--	<20	<20	<20

[a] -- = Sample lost; sample container broken during shipment.
[b] Not a POHC for this test.

Table 15 which shows that bis(2-ethylhexyl)phthalate was also measured in three matrix spike resin samples and two method blank samples.

However, elevated phthalate levels and particularly bis(2-ethylhexyl)phthalate have been measured in flue gas MM5 samples at the CRF since the packed-tower scrubber and much of the downstream ductwork were replaced subsequent to a scrubber fire in April 1987. It is suspected that the binder in the fiber-reinforced plastic material comprising the new scrubber and downstream ductwork or the replacement scrubber packing material contains phthalates and that these are slowly eluting into the flue gas.

Phthlates aside, the data in Tables 13 and 14 show that, except for hexachloroethane in Test 7, POHC levels in flue gas samples for all tests were nondetectable. Table 16 gives sample volumes, POHC concentrations, and POHC emission rates corresponding to respective detection limits for scrubber discharge samples. Table 17 is the corresponding summary for stack gas samples.

Table 18 combines the information from Table 12 with that from Table 16 to give POHC DREs at the scrubber discharge for each test. Table 19 is the corresponding POHC DRE summary for the stack discharge from the information in Tables 12 and 17.

Table 18 shows that method detection limits resulted in calculated DREs in the scrubber discharge of greater than 99.99 percent for all POHCs except 1,3,5-trichlorobenzene for Test 8 (conventional incineration Stringfellow soil alone). Method detection limits combined with low measured feed concentrations (0.22 percent) for this POHC in this test allowed only that DRE was greater than 99.9898 percent to be established. In many instances,

TABLE 15. BIS(2-ETHYLHEXYL)PHTHALATE CONCENTRATIONS IN MATRIX SPIKE AND METHOD BLANK RESIN SAMPLES

	Bis(2-ethylhexyl)phthalate concentration (μg/extract)	
Test	Matrix spike resin samples	Method blank resin samples
Test 1 (12-9-87)	<40	<40
Test 2 (12-11-87)	<40	<40
Test 4 (1-14-88)	140	140
Test 5 (1-20-88)	59	27
Test 6 (1-21-88)	<20	<20
Test 7 (1-27-88)	<20	<20
Test 8 (1-29-88)	120	<20

TABLE 16. SCRUBBER DISCHARGE FLUE GAS POHC EMISSION RATES

Parameter	Test 1 (12-9-87)		Test 2 (12-11-87)		Test 3 (12-17-87)	Test 4 (1-14-88)	Test 5 (1-20-88)		Test 6 (1-21-88)		Test 7 (1-27-88)	Test 8 (1-29-88)
	Train 1	Train 2	Train 1	Train 2			Train 1	Train 2	Train 1	Train 2		
Flue gas volume sampled (dscm)	4.56	4.74	4.28	4.16	4.01	4.67	4.69	5.07	4.64	4.17	5.02	4.55
POHC concentration												
Hexachloroethane												
(µg/train)	--	--	--	--	--	--	31	110	--	--	25	<20
(µg/dscm)	--	--	--	--	--	--	6.6	22	--	--	5.0	<4.4
All others												
(µg/train)	<40	<40	<40	<200	<40	<20	<20	<20	<20	<20	<20	<20
(µg/dscm)	<8.8	<8.4	<9.4	<48	<10	<4.3	<4.3	<3.9	<4.3	<4.8	<4.0	<4.4
Flue gas flowrate (dscm/min)	33.4		28.7		26.4	26.1	24.6		31.0		29.9	37.6
POHC emission rate (mg/hr)												
Hexachloroethane	--	--	--	--	--	--	9.8	32	--	--	8.9	<9.9
All others	<18	<17	<16	<76	<16	<6.7	<6.3	<5.8	<7.8	<8.7	<7.1	<9.9
Sampling period (hr)	4.15		3.63		4.08	4.07	5.45		3.83		4.28	2.90
Sampling period emissions (mg)												
Hexachloroethane	--	--	--	--	--	--	53	170	--	--	38	<29
All others	<73	<70	<58	<280	<64	<27	<34	<32	<30	<33	<31	<29

TABLE 17. STACK GAS POHC EMISSION RATES

	Test 2 (12-11-87)	Test 3 (12-17-87)	Test 4 (1-14-88)	Test 5 (1-20-88)	Test 7 (1-27-88)	Test 8 (1-29-88)
Flue gas volume sampled (dscm)	5.25	4.57	5.35	5.30	4.70	4.63
POHC concentration						
Hexachloroethane						
(μg/train)	--	--	--	220	77	<20
(μg/dscm)	--	--	--	42	16	<4.3
All others						
(μg/train)	<40	<40	a	<20	<20	<20
(μg/dscm)	<7.6	<8.8	a	<3.8	<4.3	<4.3
Flue gas flowrate (dscm/min)	31.1	25.3	31.5	29.1	24.4	38.5
POHC emission rate (mg/hr)						
Hexachloroethane	--	--	--	72	24	<10.0
All others	<14	<13	a	<6.6	<6.2	<10.0
Sampling period (hr)	4.07	4.08	4.08	4.57	4.55	3.08
Sampling period emission (mg)						
Hexachloroethane	--	--	--	330	110	<31
All others	<58	<54	a	<30	<28	<31

[a] Extract sample lost; sample container broken during shipment.

TABLE 18. SCRUBBER DISCHARGE POHC DREs

	POHC DRE (%)							
	Naphthalene	**Acenaphthylene**	**Fluorene**	**Phenanthrene**	**Anthracene**	**Fluoranthene**	**Hexachloroethane**	**1,3,5-Trichlorobenzene**
Test 1 (12-9-87)								
Train 1	>99.99934	>99.9975	>99.9945	>99.9985	>99.9951	>99.9979	--	--
Train 2	>99.99936	>99.9976	>99.9947	>99.9986	>99.9953	>99.9980	--	--
Test 2 (12-11-87)								
Train 1	>99.99924	>99.9967	>99.9933	>99.9984	>99.9945	>99.9974	--	--
Train 2	>99.9964	>99.9841	>99.9676	>99.9920	>99.9735	>99.9875	--	--
Test 3 (12-17-87)	>99.99896	>99.9955	>99.9937	>99.9979	>99.9933	>99.9960	--	--
Test 4 (1-14-88)	>99.99978	>99.99910	>99.9982	>99.99948	>99.9983	>99.9989	--	--
Test 5 (1-20-88)								
Train 1	>99.99989	>99.99958	>99.99914	>99.99976	>99.99922	>99.99949	--	--
Train 2	>99.99990	>99.99961	>99.99919	>99.99977	>99.99927	>99.99952	--	--
Test 6 (1-21-88)								
Train 1	>99.99991	>99.99965	>99.99930	>99.99980	>99.99935	>99.99953	--	--
Train 2	>99.99990	>99.99961	>99.99923	>99.99978	>99.99929	>99.99948	--	--
Test 7 (1-27-88)	--	--	--	--	--	--	99.9958	>99.9933
Test 8 (1-29-88)	--	--	--	--	--	--	>99.9944	>99.9898

TABLE 19. STACK DISCHARGE POHC DREs

	POHC DRE (%)							
	Naphthalene	Acenaphthylene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Hexachloroethane	1,3,5-Trichlorobenzene
Test 2 (12-11-87)	>99.99924	>99.9967	>99.9933	>99.9984	>99.9945	>99.9974	--	--
Test 3 (12-17-87)	>99.99912	>99.9962	>99.9947	>99.9982	>99.9944	>99.9966	--	--
Test 4 (1-14-88)	>99.99977	>99.99903	>99.9980	>99.99944	>99.9982	>99.9988	--	--
Test 5 (1-20-88)	>99.99990	>99.99963	>99.99924	>99.99979	>99.99931	>99.99955	--	--
Test 7 (1-27-88)	--	--	--	--	--	--	99.9962	>99.9939
Test 8 (1-29-88)	--	--	--	--	--	--	>99.9940	>99.9898

detection limits allowed DREs greater than 99.9999 percent for POHCs at higher waste feed concentrations to be established. Since all POHC DREs for all tests were >99.99 percent (with one exception), no statement concerning the relationship between conventional incineration performance and Pyretron system performance is possible. The good DRE performance in all tests is understandable given that all tests were performed at relatively high kiln and afterburner temperatures. As discussed in Section 5.2, average kiln temperature was 921°C (1,690°F) or greater and average afterburner temperature was 1,121°C (2,050°F) for all tests.

Table 19 indicates similar conclusions for the stack discharge after flue gas passage through the CRF carbon bed absorber and HEPA filter. Measured DREs at this location were greater than 99.993 percent, up to greater than 99.9999 percent for all POHCs in all tests except Test 4 (no data) and for 1,3,5-trichlorobenzene for Test 8. A DRE of greater than 99.9898 percent for 1,3,5-trichlorobenzene in Test 8 could not be established because of method detection limits coupled with low feed concentration.

7.3 PARTICULATE EMISSIONS

Particulate concentrations in the flue gas at the two locations sampled are summarized in Table 20. Particulate levels were measured in the stack for all tests. Limitations in sampling port availability precluded the

TABLE 20. PARTICULATE EMISSION SUMMARY

	Particulate concentration (mg/dscm at 7 percent O_2)[a]	
	Scrubber discharge flue gas	Stack gas
Test 1 (12-9-87)	--[b]	8
Test 2 (12-11-87)	--	9
Test 3 (12-17-87)	21	99
Test 4 (1-14-88)	26	59
Test 5 (1-20-88)	--	63
Test 6 (1-21-88)	--	21
Test 7 (1-27-88)	27	37
Test 8 (1-29-88)	38	38

[a] Measured particulate concentration directly corrected to 7 percent O_2 using flue gas O_2 level. This does not provide a direct comparison for tests with O_2 enhancement (Tests 3 through 7).

[b] -- denotes measurements not performed.

measurement of scrubber discharge flue gas particulate levels for the tests during which simultaneous MM5 sampling was performed (Tests 1, 2, 5, and 6).

The data in Table 20 show that particulate levels in the scrubber discharge flue gas for three Pyretron tests and one conventional incineration test were in the 20 to 40 mg/dscm at 7 percent O_2 range. Levels comparable to these or increased were measured in the stack gas. All levels measured were below the incinerator performance standard of 180 mg/dscm at 7 percent O_2.

The footnote to Table 20 notes that corrections to 7 percent O_2 were performed using the measured flue gas O_2. The effect of such a correction is to correct for dilution air so that emissions under different flue gas O_2 levels can be compared on a common basis. This simple correction approach does not yield a true basis for comparison when oxygen enrichment of the combustion process is used. When oxygen enrichment is used, the O_2/N_2 ratio of the oxidant (air + O_2) is increased. When subsequent correction to 7 percent O_2 is done, proportionally more diluent gas is "removed" in an O_2 enrichment case than in an air-only combustion case with the same amount of O_2 introduced to the combustor. Thus, corrected emissions are higher in the O_2 enrichment case than in the air-only case. The O_2 enrichment case is thereby "penalized."

No further correction to account for this "O_2 penalty" was performed here. Nevertheless, all emission levels reported are less than the incinerator performance standard without further correction.

7.4 INCINERATION RESIDUALS

The composite scrubber blowdown liquor samples and composite kiln ash samples from each test were extracted and analyzed for the test POHCs and other Method 8270 semivolatile organic hazardous constituents. No POHC was detected in any blowdown sample at a detection limit of 20 µg/L, and no other semivolatile organic hazardous constituent was detected at detection limits ranging from 100 µg/L (nitrophenols and pentachlorophenol) to 20 µg/L (all other Method 8270 constituents). No POHC analyte was detected in any kiln ash sample at a detection limit of 0.4 mg/kg ash. No other semivolatile organic hazardous constituent was detected at detection limits ranging from 2.0 mg/kg (nitrophenols and pentachlorophenol) to 0.4 mg/kg (all other Method 8270 constituents) with the exception of bis(2-ethylhexyl)phthalate. This compound was measured in the kiln ash sample from Tests 5 and 6 at 0.86 and 0.40 mg/kg, respectively. These levels are likely due to contamination for these samples.

Since semivolatile organics were not detected in any residual sample, it is clear that firing mode (air-only or O_2 enhanced) had no measurable effect on residue composition.

SECTION 8

CONCLUSIONS

A series of demonstration tests of the American Combustion, Inc., Pyretron Thermal Destruction System was performed under the Superfund Innovative Technology Evaluation (SITE) program. The system, which comprises an oxygen-enhanced burner system consisting of rotary kiln and afterburner combustor burners capable of introducing both air and oxygen to the combustion process, a gas (fuel, air, and oxygen) metering and control assembly, a computer-based control system with proprietary control logic, an oxygen supply system, and a kiln water injection system for augmented temperature control, was retrofit to the rotary kiln incineration system (RKS) at EPA's Combustion Research Facility. The demonstration program was performed using contaminated soil from the Stringfellow Superfund site. For most tests, the Stringfellow waste was combined with a listed hazardous waste, K087, which is decanter tank tar sludge from coking operations. This combined waste was chosen so that the test waste could have significant heat and POHC content and, thereby, present a challenge to the incineration process. The mixed waste consisted of 60 percent (weight) K087 and 40 percent Stringfellow soil. In all tests, the test waste was batch charged to the RKS using a ram feed system which fed waste packed into fiberpack drums.

The demonstration program consisted of emissions testing of a condition challenging the limit of capability of a conventional air-only incineration process in terms of feed mass per charge and total waste feedrate. Results were then compared to similar testing under the following three modes of Pyretron O_2 enhanced operation:

- The same waste feed schedule and auxiliary fuel flow as established in the optimum conventional incineration test
- Increased charge mass at constant total feedrate
- Increased (doubled) total waste feedrate at constant charge mass

8.1 DEMONSTRATION PROGRAM CONCLUSIONS

The objective of the demonstration tests was to provide the data to evaluate three ACI claims regarding the Pyretron system as follows:

- The Pyretron system with dynamic oxygen enhancement reduces the magnitude of the transient high levels of organic emissions, CO, and soot ("puffs") that occur with repeated batch charging of waste fed to a rotary kiln

- The Pyretron system with oxygen enhancement is capable of achieving the RCRA-mandated 99.99 percent destruction and removal efficiency (DRE) of principal organic hazardous constituents (POHCs) in wastes incinerated at a higher waste feedrate than conventional air-only incineration
- The Pyretron system is more economical than conventional incineration

With respect to the first ACI claim, test results are inconclusive. Initial scoping tests confirmed that a waste feed schedule of 10.9 kg (24 lb) every 10 min (65.5 kg/hr (140 lb/hr) total feedrate) gave unacceptable operation under conventional incinerator operation. The Pyretron system was capable of acceptable operation at increased charge mass of 15.5 kg (34 lb), but charge frequency was decreased to every 19.5 min. Thus, total feedrate was decreased to 47.7 kg/hr (105 lb/hr). Both conventional and Pyretron O_2 enhanced incineration resulted in acceptable operation at a feed schedule of 9.6 kg (21 lb) every 12 min, or 47.7 kg/hr (105 lb/hr).

The only available measures of the magnitude of transient puffs in the test program were those recorded by the CO and unburned hydrocarbon emission monitors. Flue gas unburned hydrocarbon levels were uniformly low for all tests. Kiln exit CO peaks were quite frequent for conventional incineration at high waste feedrate (65.5 kg/hr (140 lb/hr)). Kiln exit CO levels were more steady for the lower waste feedrate tests (47.7 kg/hr (105 lb/hr)) regardless of firing mode (conventional air-only versus Pyretron O_2 enhanced) or batch waste charge mass. However, test-to-test variability in the kiln exit CO data was such that no clear differences between conventional incineration and Pyretron O_2 enhanced performance were apparent. Thus, it was not possible to clearly measure decreases in transient puff magnitudes. This limitation notwithstanding, test results do clearly establish that a 60-percent increase in charge mass over the capability limit of conventional incineration is possible with the Pyretron O_2 enhanced system.

With respect to the second vendor claim, test results clearly indicate that 99.99 percent POHC DRE was achieved with the Pyretron O_2 enhanced system with waste feedrate doubled (to 95.5 kg/hr (210 lb/hr) versus 47.7 kg/hr (105 lb/hr) for conventional incineration) over the limit established under conventional operation. Acceptable operation with the Pyretron O_2 enhanced system was achieved at a feed schedule of 9.6 kg (21 lb) every 6 min, or 95.5 kg/hr (210 lb/hr). Greater than 99.99 percent DRE for all POHCs and particulate emissions of significantly less than 180 mg/dscm at 7 percent O_2 were measured.

Operating at this increased waste feedrate with the Pyretron O_2 enhanced system necessitated the addition of water to the kiln to control kiln temperature. This water was a required heat sink to compensate for the removed heat sink represented by the nitrogen in the air that the oxygen stream replaced.

Evaluation of the vendor's third claim is discussed in the companion Applications Analysis report (2).

Other test conclusions are as follows:

- Flue gas POHC levels were nondetectable for all tests (air-only and O_2 enhanced) in which the mixed K087/Stringfellow waste was incinerated. Corresponding POHC DREs were greater than 99.99 percent to greater than 99.9999 percent.
- Two tests (air-only and O_2 enhanced) were performed firing Stringfellow soil alone. For these tests, the soil was spiked with hexachloroethane and 1,3,5-trichlorobenzene. Hexachloroethane DRE in the scrubber discharge flue gas was 99.9944 or greater for both tests. 1,3,5-trichlorobenzene was not detected in any flue gas sample. However, method detection limits combined with low feed concentration (0.22 percent measured) only allowed it to be established that greater than 99.9898 percent DRE was achieved for conventional incineration.
- Flue gas particulate levels were significantly less than 180 mg/dscm at 7 percent O_2 in all test measurements.
- Scrubber blowdown and kiln ash contained no detectable levels of test POHCs.

Deviations from the test program quality assurances project plan (QAPP) and analysis method protocols occurred on some occasions during the test program. In addition, a few QAPP-specified data quality objectives (DQOs) were not achieved. These issues are discussed in Section 9. This discussion confirms that the conclusions from this test program are not affected by discrepancies in adherance to the QAPP or by occasional failure to achieve DQOs. The conclusions stated above are clearly supported by the test program data.

8.2 DEMONSTRATION PROGRAM COSTS

The major portion of the costs of the Pyretron system SITE demonstration program was associated with preparing the demonstration plan, performing the demonstration, including operating the incinerator with the Pyretron system installed, and performing the test program sampling and analysis efforts; evaluating the demonstration test data; and preparing the demonstration test report. However, many of the costs incurred would apply to some degree to an actual field application of this technology. These costs bear noting here since they give some insight into the magnitude of possible field application costs. These application-specific costs include the prototype Pyretron system hardware costs and the utility costs expended during the demonstration program.

ACI estimates that it incurred $50,000 in prototype system design and process control algorithm development efforts. ACI further estimates that the prototype system installed at the CRF cost $150,000.

The two major utility costs for the demonstration were for auxiliary fuel (propane) and for oxygen. Oxygen was supplied to the program by Big Three Industries at no cost. The demonstration tests consumed about 36,800 sm^3 (1,300 MSCF) of oxygen. At typical oxygen costs of between $0.088 and

$0.194/sm^3 ($2.50 to $5.50/MSCF), between $3,250 and $4,875 worth of oxygen was consumed over the test program.

A total of 1,760 GJ (1,670 million Btu) of propane was consumed over the demonstration test program. At a typical propane cost of between $2.84 to $5.70/GJ ($3.00 to $6.00/million Btu), between $5,000 and $10,000 worth of propane was consumed over the test O_2 enhanced program. About 40 percent of the propane was fired during the Pyretron system tests. The remaining 60 percent was consumed during the conventional incineration tests.

SECTION 9

QUALITY ASSURANCE

As noted in Section 1, the objective of the demonstation test program was to supply the data needed to evaluate the three claims made by the developer of the Pyretron Thermal Destruction System. The critical data needed to support the test objective were measurements of incinerator destruction and removal efficiency (DRE), specifically waste feed and flue gas concentrations of the designated POHCs for these tests; incinerator particulate emissions; and incinerator flue gas O_2, CO_2, CO, and TUHC levels at various locations as measured by continuous emissions monitors (CEMs). Of secondary importance are data on POHC concentrations in the residual discharge streams, namely the scrubber blowdown and kiln ash.

A quality assurance project plan (QAPP) was prepared for these tests and approved in November 1987. In accordance with this plan, QA efforts performed to ensure that data quality is known for the particulate and CEM measurements involved adherence to Reference Method procedures and CEM manufacturers' specifications. No deviations from the QAPP occurred for these measurements with the exception that not all monitors were in operation for all tests as noted in Section 6.

The QAPP specified that assurance that data of known quality would result from measurements of POHC concentrations in waste feed, flue gas, scrubber blowdown, and kiln ash would rely on adherence to sampling and analysis method procedures. These method-specified procedures call for spiking all samples to be extracted and analyzed for POHCs with method surrogate compounds and for analyzing matrix spike samples. The methods also place limits on sample hold times before extraction and between extraction and analysis.

Several deviations from the QAPP and method protocol occurred during the course of the test program. The deviations involved excessive sample hold times and inadvertent failure to initially spike surrogates into a few samples. These are discussed in the following subsections. Section 9.5 summarizes test QA findings and concludes that the deviations which occurred have no impact on test conclusions reached and that data reported are of known quality.

9.1 SAMPLE HOLD TIMES

Several sample hold time exceedences arose from a change in test plans over the course of the tests. The original test plan called for performing all Method 8270 analyses at the CRF onsite laboratory. However, as a result of a QA technical systems review (TSR) of the CRF laboratory performed on January 19 and 20, 1988, it became clear that the analytical instrumentation and analytical systems in place were not at the time sufficient to ensure that data of known quality would result. As a consequence, it was decided to perform all Method 8270 analyses at an offsite laboratory. The timing of this decision, however, was such that extract hold times for Tests 1 and 2 performed in early December 1987 could not be met.

A subsequent QA TSR of the analyses of the Tests 1, 2, and 3 samples performed on February 5 raised further issues which required resolution. As a consequence, the analyses of Tests 4 through 8 samples were placed on hold by the EPA Project Officer until all issues were resolved. Project Officer approval to proceed with Tests 4 through 8 analyses was not received until February 25. The timing of this decision was such that Test 4 samples could not be analyzed within hold times.

In both instances, sample scheduling was such that samples which could be analyzed within hold time limits were analyzed ahead of samples which could not be analyzed within hold time limits.

Tables 21 through 24 list extraction and analysis hold times for waste feed, flue gas MM5 train, scrubber blowdown, and kiln ash samples, respectively. Table 22 shows that extraction hold times for MM5 train samples were met for all tests. All MM5 train samples are routinely extracted at the CRF the day after a given test.

Table 21 shows that initial extraction hold times were met for all feed samples except matrix spike samples. However, the initial feed samples for Tests 1, 2, and 3 were not spiked with surrogates. When this oversight was discovered, archive samples were retrieved, spiked, extracted, and analyzed. However, extraction hold times were exceeded for those second extractions.

Special mention of the matrix spike feed samples is warranted. Feed samples corresponding to the test dates noted in Table 21 were taken and spiked with matrix spike compounds. Spiked samples were then immediately extracted. Thus, although the spiked samples were extracted within extraction hold time limits of their preparation, the native waste samples were 16 to 29 days old.

Tables 23 and 24 show that initial extraction hold times were met for all blowdown and kiln ash samples except those associated with Tests 5 and 6. As for feed samples, initial blowdown and kiln ash samples were not surrogate spiked. Again, archive samples were retrieved, spiked, extracted, and analyzed. Again, extraction hold times were exceeded for the second extraction.

Tables 21 through 24 show that no samples for Tests 1, 2, and 4 were analyzed within analysis hold time limits. Reasons for this failure were discussed above. The blowdown method blank sample was also analyzed after hold time had passed. All samples for Tests 3, 5, 6, 7, and 8 were analyzed within hold time limits with the exception of all initial waste feed samples (second extractions were analyzed within hold time limits) and the MM5 matrix

TABLE 21. SAMPLE HOLD TIMES FOR WASTE FEED SAMPLES

Sample	Collection date	Extraction date	Extraction hold time (days)	Analysis date	Analysis hold time (days)
Method requirement			7		40
Test samples					
Test 1	12-9-87	12-15-87	6	2-3-88	50
Test 1, second extraction[a]	12-9-87	2-17-88	70	3-21-88	33
Test 2	12-11-87	12-15-87	4	2-3-88	50
Test 2, second extraction[a]	12-11-87	2-17-88	68	3-21-88	33
Test 3	12-17-87	12-22-87	5	2-3-88	43
Test 3, second extraction[a]	12-17-87	2-17-88	62	3-21-88	33
Test 4	1-14-88	1-18-88	4	3-20-88	62
Test 5	1-20-88	1-26-88	6	3-20-88	54
Test 6	1-21-88	1-26-88	5	3-20-88	54
Test 7	1-27-88	2-5-88	8	3-21-88	45
Test 8	1-29-88	2-5-88	7	3-21-88	45
Matrix spike samples					
Test 4	1-14-88	2-12-88	29[b]	3-20-88	37
Test 7	1-27-88	2-12-88	16[b]	3-20-88	37

[a] Surrogates inadvertently omitted from initial extraction; sample subsequently spiked with surrogates and reextracted.

[b] Feed samples from test dates noted were spiked with matrix spike compounds and extracted on extraction date shown.

TABLE 22. SAMPLE HOLD TIMES FOR MM5 TRAIN SAMPLES

Sample	Collection date	Extraction date	Extraction hold time (days)	Analysis date	Analysis hold time (days)
Method requirement			7		40
Scrubber discharge MM5 trains					
Test 1, Train 1	12-9-87	12-10-87	1	1-28-88	49
Test 1, Train 2	12-9-87	12-10-87	1	1-28-88	49
Test 2, Train 1	12-11-87	12-12-87	1	1-28-88	47
Test 2, Train 2	12-11-87	12-12-87	1	1-28-88	47
Test 3	12-17-87	12-18-87	1	1-27-88	40
Test 4	1-14-88	1-15-88	1	3-16-88	61
Test 5, Train 1	1-20-88	1-21-88	1	2-28-88	38
Test 5, Train 2	1-20-88	1-21-88	1	2-28-88	37
Test 6a, Train 1	1-21-88	1-22-88	1	2-28-88	37
Test 6a, Train 2	1-21-88	1-22-88	1	2-28-88	37
Test 7	1-27-88	1-28-88	1	2-29-88	32
Test 8	1-29-88	1-30-88	1	3-1-88	31
Stack MM5 trains					
Test 2	12-11-87	12-12-87	1	1-28-88	47
Test 3	12-17-87	12-18-87	1	1-27-88	40
Test 4	1-14-88	1-15-88	1	--[a]	--[a]
Test 5	1-20-88	1-21-88	1	2-28-88	38
Test 7	1-27-88	1-28-88	1	2-29-88	32
Test 8	1-29-88	1-30-88	1	3-1-88	31
Matrix spike resin					
Test 1	12-9-87	12-10-87	1	2-3-88	55
Test 2	12-11-87	12-12-87	1	2-3-88	53
Test 3	12-17-87	12-18-87	1	2-3-88	47
Test 4	1-14-88	1-15-88	1	3-16-88	61
Test 5	1-20-88	1-21-88	1	2-28-88	38
Test 7	1-27-88	1-28-88	1	2-29-88	32
Test 8	1-29-88	1-30-88	1	3-1-88	31
Method blank resin					
Test 1	12-9-87	12-10-87	1	2-3-88	55
Test 2	12-11-87	12-12-87	1	2-3-88	53
Test 4	1-14-88	1-15-88	1	3-16-88	61
Test 5	1-20-88	1-21-88	1	2-29-88	39
Test 6	1-21-88	1-22-88	1	2-29-88	38
Test 7	1-27-88	1-28-88	1	3-1-88	33
Test 8	1-29-88	1-30-88	1	3-1-88	31

[a] Sample lost; container broken during shipment.

TABLE 23. SAMPLE HOLD TIMES FOR BLOWDOWN LIQUOR SAMPLES

Sample	Collection date	Extraction date	Extraction hold time (days)	Analysis date	Analysis hold time (days)
Method requirement			7		40
Test samples					
Test 1	12-9-87	12-14-87	6	Not analyzed	
Test 1, second extraction[a]	12-9-87	1-30-88	50	3-17-88	47
Test 2	12-11-87	12-14-87	5	1-28-88	45
Test 2, second extraction[a]	12-11-87	1-30-88	50	3-17-88	47
Test 3	12-17-87	12-22-87	5	1-27-87	36
Test 3, second extraction[a]	12-17-87	1-30-88	50	3-17-88	47
Test 4	1-14-88	1-15-88	1	3-16-88	61
Test 5	1-20-88	1-30-88	10	2-28-88	29
Test 6	1-21-88	1-30-88	9	2-28-88	29
Test 7	1-27-88	1-30-88	3	2-29-88	30
Test 8	1-29-88	2-1-88	3	3-1-88	29
Matrix spike samples					
Test 5	1-20-88	1-30-88	10	2-29-88	30
Test 7	1-27-88	1-30-88	3	3-1-88	32
Method blank sample	NA	1-30-88	1	3-15-88	45

[a] Surrogates inadvertently omitted from initial extraction; sample subsequently spiked with surrogates and reextracted.

TABLE 24. SAMPLE HOLD TIMES FOR KILN ASH SAMPLES

Sample	Collection date	Extraction date	Extraction hold time (days)	Analysis date	Analysis hold time (days)
Method requirement			7		40
Test samples					
Test 1	12-9-87	12-14-87	5	Not analyzed	
Test 1, second extraction[a]	12-9-87	2-16-88	69	3-17-88	30
Test 2	12-11-87	12-14-87	3	2-3-88	51
Test 2, second extraction[a]	12-11-87	2-16-88	67	3-17-88	30
Test 3	12-17-87	12-22-87	5	1-27-87	36
Test 3, second extraction[a]	12-17-87	2-16-88	61	3-17-88	30
Test 4	1-14-88	1-16-88	2	3-16-88	60
Test 5	1-20-88	1-29-88	9	2-28-88	29
Test 6	1-21-88	1-30-88	9	2-28-88	29
Test 7	1-27-88	1-30-88	3	2-29-88	30
Test 8	1-29-88	1-30-88	1	3-1-88	31
Matrix spike samples					
Test 5	1-20-88	1-29-88	9	2-29-88	31
Test 7	1-27-88	1-30-88	3	2-29-88	30
Method blank sample	NA	2-23-88		3-15-88	21

[a] Surrogates inadvertently omitted from initial extraction; sample subsequently spiked with surrogates and reextracted.

spike sample for Test 3. Feed samples were purposely analyzed last. These high-level organic samples can be troublesome and cause delays.

The possible effects of hold time exceedences on data quality are discussed in the following subsection.

9.2 SURROGATE RECOVERIES

9.2.1 Surrogate Recovery Results

As specified in the QAPP for these tests, all samples for Method 8270 analysis were to have been spiked with octafluorbiphenyl and 9-phenylanthracene surrogate compounds. Feed, blowdown, and kiln ash samples for Tests 1, 2, and 3 were not initially spiked. Subsequent spiked samples were not extracted within method hold requirements.

Tables 25 through 28 list surrogate recoveries measured for waste feed, MM5 train samples, scrubber blowdown, and kiln ash samples, respectively. The data in Table 25 show that surrogate recovery from waste feed and feed matrix spike samples ranged from 53 to 123 percent. The data quality objective (DQO) for surrogate recovery was 50 to 150 percent. All measured recoveries were within the DQO range. The DQO for this measurement was achieved.

All test waste feed samples from Tests 4, 5, and 6 were analyzed after hold time had expired. Waste feed samples for Tests 1, 2, and 3 and matrix spike feed samples were analyzed within hold time limits, although they were extracted after extraction hold time had expired. However, surrogate recoveries for all samples were acceptable. Clearly, the hold time exceedences experienced had no affect on data quality as measured by surrogate recovery.

Table 26 shows that surrogate recoveries from MM5 train test samples ranged from 14 to 157 percent and averaged 75 percent for octafluorobiphenyl and 72 percent for 9-phenylanthracene. Overall, of 62 individual measurements, 54, or 87 percent were within the DQO range of 50 to 150 percent. The completeness DQO for this measurement was 70 percent; this DQO was achieved.

Interestingly, surrogate recoveries for MM5 train samples which were analyzed after hold time had expired are not visibly different from those analyzed within hold time limits. In fact, the mean octafluorobiphenyl recovery for the 13 samples analyzed after hold time had expired was 78 percent with a standard deviation of 27 percent. The mean octafluorobiphenyl recovery for the 18 samples analyzed within hold time limits was 72 percent with a standard deviation of 17 percent. Corresponding values for 9-phenylanthracene recovery was a mean of 72 percent with standard deviation of 33 percent for samples analyzed after hold time had expired and a mean of 72 percent with standard deviation of 22 percent for samples analyzed within hold time limits. Clearly, surrogate recoveries for samples analyzed after analysis hold time had expired are no different from those for samples

TABLE 25. SURROGATE RECOVERIES FOR WASTE FEED SAMPLES

	Surrogate recovery (%)			
	Test samples		Matrix spike samples	
Test	Octafluoro-biphenyl	9-Phenyl-anthracene	Octafluoro-biphenyl	9-Phenyl-anthracene
1 (12-9-87)	105	111		
2 (12-11-87)	79	75		
3 (12-17-87)	100	123		
4 (1-14-88)	103	91	83	78
5 (1-20-88)	91	89		
6 (1-21-88)	96	96		
7 (1-27-88)	99	117	102	90
8 (1-29-88)	103	53		
Mean	97	94	93	84
Median	99, 100	91, 96	83, 102	78, 90
All Samples				
Mean	96	92		
Median	99, 100	90, 91		

TABLE 26. SURROGATE RECOVERIES FOR MM5 TRAIN SAMPLES

	Surrogate recovery (%)							
	Scrubber discharge flue gas samples		Stack gas samples		Matrix spike resin samples		Method blank resin samples	
Test	Octafluoro-biphenyl	9-Phenyl-anthracene	Octafluoro-biphenyl	9-Phenyl-anthracene	Octafluoro-biphenyl	9-Phenyl-anthracene	Octafluoro-biphenyl	9-Phenyl-anthracene
1 (12-9-87)								
Train 1	55	37			83	78	97	90
Train 2	62	46						
2 (12-11-87)								
Train 1	71	57	67	70	86	94	76	80
Train 2	61	18						
3 (12-17-87)	77	54	71	24	157	154		
4 (1-14-88)	71	66	--[a]	--[a]	63	69	60	78
5 (1-20-88)								
Train 1	72	75	106	101	63	90	72	75
Train 2	82	81						
6 (1-21-88)								
Train 1	80	83					68	96
Train 2	71	72						
7 (1-27-88)	86	81	81	69	69	75	67	86
8 (1-29-88)	75	77	81	77	72	68	14	17
Mean	72	62	81	68	85	90	65	75
Median	71,72	66,72	81	70	72	78	68	80
All samples								
Mean	75	72						
Median	72	75						

[a] Sample lost; container broken during shipment.

TABLE 27. SURROGATE RECOVERIES FOR BLOWDOWN LIQUOR SAMPLES

	Surrogate recovery (%)					
	Test samples		Matrix spike samples		Blank samples	
Test	Octafluoro-biphenyl	9-Phenyl-anthracene	Octafluoro-biphenyl	9-Phenyl-anthracene	Octafluoro-biphenyl	9-Phenyl-anthracene
1 (12-9-87)	14	85				
2 (12-11-87)	12	78				
3 (12-17-87)	18	74				
4 (1-14-88)	15	60				
5 (1-20-88)	13	57	12	55		
6 (1-21-88)	14	76				
7 (1-27-88)	17	73	14	47		
8 (1-29-88)	1	15			12	17
Mean	13	65	13	51	12	17
Median	14	73, 74	12, 14	47, 55	12	17
All samples						
Mean	13	58				
Median	14	60				

TABLE 28. SURROGATE RECOVERIES FOR KILN ASH SAMPLES

	Surrogate recovery (%)					
	Test samples		Matrix spike samples		Blank samples	
Test	Octafluorobiphenyl	9-Phenylanthracene	Octafluorobiphenyl	9-Phenylanthracene	Octafluorobiphenyl	9-Phenylanthracene
1 (12-9-87)	35	94				
2 (12-11-87)	39	75				
3 (12-17-87)	47	62				
4 (1-14-88)	44	70				
5 (1-20-88)	50	6	56	3		
6 (1-21-88)	54	15				
7 (1-27-88)	66	92	70	78		
8 (1-29-88)	64	97			72	41
Mean	50	64	63	41	72	41
Median	47, 50	70, 75	56, 70	3, 78	72	41
All samples						
Mean	54	58				
Median	54	70				

analyzed within hold time limits. These surrogate recovery data confirm that the analysis hold time exceedences had no effect on data quality.

Table 27 shows that surrogate recoveries from blowdown liquor test samples ranged from 1 to 85 percent, averaging 13 percent for octafluorobiphenyl and 58 percent for 9-phenylanthracene. 9-phenylanthracene recoveries were uniformly better than octafluorobiphenyl recoveries. No octafluorobiphenyl recovery met the DQO of 50 to 150 percent. Eight of 11 9-phenylanthracene recoveries, or 73 percent of the measurements, met the DQO. The completeness DQO for the measurement was 70 percent. This DQO was met for 9-phenylanthracene recovery but not for octafluorobiphenyl recovery.

Interestingly, surrogate recoveries were generally better for samples analyzed after hold time had elapsed (Tests 1 through 4, and the method blank) than for samples analyzed within the hold time limit (Tests 5 through 8 and the matrix spike samples). The mean octafluorobiphenyl recovery from the 5 samples analyzed after hold time had expired was 14 percent with a standard deviation of 2 percent. Corresponding octafluorobiphenyl mean recovery from the 6 samples analyzed within hold time limits was a comparable 12 percent with a standard deviation of 6 percent. The mean 9-phenylanthrancene recovery from samples analyzed after hold time had expired was 63 percent with a standard deviation of 27 percent. Corresponding 9-phenylanthracene mean recovery from samples analyzed within hold time limits was a slightly poorer 54 percent with standard deviation of 22 percent. Clearly, the analytical hold time exceedences did not affect data quality as measured by surrogate recovery. Exceeding extraction hold time would not be expected to affect surrogate recovery since surrogates were spiked just before extraction, not when the samples were collected.

9-phenylanthracene recovery from kiln ash samples was comparable to that from the blowdown samples. Octafluorobiphenyl recovery was generally better. Recovery from test samples ranged from 3 to 97 percent and averaged 54 percent for octafluorobiphenyl and 58 percent for 9-phenylanthracene. Of 22 measurements performed, 14, or 64 percent, had surrogate recovery in the DQO range of 50 to 150 percent. Only the kiln ash sample from Test 4 was analyzed after analytical hold time had elapsed. Surrogate recovery from this sample was comparable to that from samples analyzed within hold time limits. Again, this confirms that the hold time exceedences experienced had little effect on data quality.

As mentioned in several instances in the preceeding discussion, initial test blowdown and kiln ash samples for Tests 1, 2, and 3 were not surrogate spiked. Archive samples were subsequently retrieved, spiked, extracted, and analyzed, but by the time this was done, extraction hold time had elapsed. It may be concluded from these occurrences that the data from the blowdown and kiln ash analyses for Tests 1, 2, and 3 are of unknown quality. However, all available test data confirm just the contrary. Target analytes were not detected in any blowdown or kiln ash sample. Initial blowdown and kiln ash samples from Tests 2 and 3 (extracted within hold time limits); surrogate spiked blowdown and ash samples from Tests 1, 2, and 3; and blowdown and ash samples from Tests 4 through 8 were all analyzed to contain nondetectable amounts of the test POHCs. A test program conclusion that all samples were free of residual POHC is warranted.

Surrogate recovery from blowdown (one surrogate) and ash (both surrogates) samples were lower than DQO levels. Detection limits can be adjusted for surrogate recovery if desired. The conclusion that no detectable POHC was found in any blowdown or kiln ash sample remains unchanged.

9.2.2 Corrections For Surrogate Recoveries

As noted in the introduction to Section 9, the critical data needed to support the test program objectives were measurements of incinerator DRE, specifically waste feed and flue gas POHC concentrations. Surrogate recoveries for the waste feeds analyzed were acceptable as noted above in Section 9.2.1. Surrogate recoveries for flue gas MM5 train analysis were also generally acceptable in that 87 percent of the measured recoveries were within acceptable (DQO-specified) limits. However, several measured recoveries were somewhat low. A low-surrogate recovery analyte measured may have been present in the sample analyzed at a concentration higher than reported. For example, if a surrogate were spiked at 50 μg but recovered at 20 μg (40 percent recovery), the implication is that an analyte reported as present at 20 μg may actually have been present at 50 μg.

For analytes reported as not detected, as was the case for virtually all POHCs in MM5 train samples for these tests, low surrogate recovery implies that the actual detection limit is higher than reported. For the 40 percent surrogate recovery example, an analyte reported as not detected at 20 μg may have been present at a 50-μg level and still not detected.

Of course, correction for surrogate recovery can be made. The correction involves simply dividing a reported concentration by the appropriate surrogate recovery. Since in these tests, several surrogate recoveries were low, conclusions based on reported MM5 train concentration data may be optimistic. For this reason, it is of interest to evaluate whether test conclusions regarding POHC DRE are still defensible in light of occasionally poor MM5 train surrogate recoveries.

Tables 29 and 30 provide the data for this evaluation. Table 29 lists POHC DREs corresponding to scrubber discharge flue gas concentrations using MM5 train data corrected for surrogate recovery. Thus, Table 29 represents Table 18 corrected for the MM5 train surrogate recoveries listed in Table 26. No correction for waste feed surrogate recovery has been made. Table 30 presents corresponding stack gas DREs, again corrected for surrogate recovery. Thus, Table 30 represents Table 19 corrected with the Table 26 recoveries. Surrogate recovery corrections were made using octafluorobiphenyl recovery for naphthalene, acenaphthylene, fluorene, hexachloroethane, and 1,3,5-trichlorobenzene correction; and 9-phenylanthracene recovery was used for anthracene, phenanthrene and fluoranthene correction.

The data in Table 29 show that test conclusions regarding scrubber discharge flue gas POHC DREs would be no different if calculated DREs are corrected for MM5 train surrogate recovery. Surrogate recovery corrected

TABLE 29. SCRUBBER DISCHARGE POHC DREs WHEN CORRECTED FOR MM5 TRAIN SURROGATE RECOVERY

	POHC DRE (%)							
	Naphthalene	Acenaphthylene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Hexachloroethane	1,3,5-Trichlorobenzene
Test 1 (12-9-87)								
Train 1	>99.9988	>99.9955	>99.9900	>99.9961	>99.9868	>99.9944	--	--
Train 2	>99.9989	>99.9962	>99.9915	>99.9970	>99.9898	>99.9957	--	--
Test 2 (12-11-87)								
Train 1	>99.9989	>99.9954	>99.9905	>99.9971	>99.9904	>99.9955	--	--
Train 2	>99.9940	>99.9739	>99.947	>99.956	>99.85	>99.931	--	--
Test 3 (12-17-87)	>99.9986	>99.9941	>99.9918	>99.9961	>99.987	>99.9926	--	--
Test 4 (1-14-88)	>99.99970	>99.9987	>99.9974	>99.99922	>99.9974	>99.9983	--	--
Test 5 (1-20-88)								
Train 1	>99.99985	>99.99942	>99.99881	>99.99968	>99.99896	>99.99932	--	--
Train 2	>99.99987	>99.99952	>99.99901	>99.99972	>99.99909	>99.99941	--	--
Test 6 (1-21-88)								
Train 1	>99.99989	>99.99956	>99.99912	>99.99976	>99.99922	>99.99944	--	--
Train 2	>99.99987	>99.99946	>99.99892	>99.99970	>99.99901	>99.99929	--	--
Test 7 (1-27-88)	--	--	--	--	--	--	99.9951	>99.9922
Test 8 (1-29-88)	--	--	--	--	--	--	>99.9926	>99.9865

TABLE 30. STACK DISCHARGE POHC DREs WHEN CORRECTED FOR MM5 TRAIN SURROGATE RECOVERY

	POHC DRE (%)							
	Naphthalene	Acenaphthylene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Hexachloroethane	1,3,5-Trichlorobenzene
Test 2 (12-11-87)	>99.99989	>99.9951	>99.9900	>99.9976	>99.9922	>99.9963	--	--
Test 3 (12-17-87)	>99.9988	>99.9946	>99.9925	>99.9927	>99.9765	>99.9860	--	--
Test 4 (1-14-88)	>99.99977	>99.99903	>99.9980	>99.99944	>99.9982	>99.9988	--	--
Test 5 (1-20-88)	>99.99991	>99.99965	>99.99928	>99.99979	>99.99932	>99.99955	--	--
Test 7 (1-27-88)	--	--	--	--	--	--	99.9953	>99.9925
Test 8 (1-29-88)	--	--	--	--	--	--	>99.9926	>99.987

scrubber discharge flue gas POHC DREs remain greater than 99.99 percent for all POHCs except anthracene in Tests 1 and 3. Anthracene was the POHC present at lowest concentration in the mixed waste feed. Correcting for less than 100 percent MM5 train surrogate recovery lowers the DRE associated with the MM5 train detection limit to just below 99.99 percent for Tests 1 and 3.

The method detection limit maximum DRE for 1,3,5-trichlorobenzene in Test 8 remains below 99.99 percent, as it was when uncorrected.

The data in Table 30 show similar conclusions for surrogate recovery corrected stack gas calculated DREs. These are still greater than 99.99 percent for all POHCs except, anthracene and fluoranthene for Test 3 and 1,3,5-trichlorobenzene for Test 8.

In summary, although MM5 train surrogate recoveries were generally less than 100 percent, and in some cases less than 50 percent, test program conclusions are not affected. Test program conclusions were that POHC DRE was greater than 99.99 percent for all tests performed. Correcting for occasional poor surrogate recovery does not alter this conclusion.

9.3 MATRIX SPIKE RECOVERIES

Seven MM5 resin samples and two each of waste feed, blowdown, and kiln ash samples coresponding to various tests were spiked with the designated POHCs for the test program, extracted, and analyzed. Tables 31 through 34 summarize the matrix spike analysis results for waste feed, MM5 resin, blowdown, and kiln ash samples, respectively.

The data in Table 31 show that matrix spike compound recovery from waste feed samples ranged from 75 to 119 percent. All recoveries measured met the DQO for this measurement of 50 to 150 percent. The completeness for this measurement was, therefore, 100 percent.

The data in Table 32 show that matrix spike compound recoveries from spiked MM5 train resin samples ranged from 62 to 115 percent. All recoveries met the DQO of 50 to 150 percent. The completeness for this measurement was, therefore, 100 percent. In addition, matrix spike compound recoveries from the four samples analyzed after hold time had expired (Tests 1 through 4) are no different, compound by compound, than recoveries from the three samples analyzed within hold time limits (Tests 5, 7, and 8). Again, the hold time exceedences experienced did not affect data quality as measured by matrix spike sample analyses.

Table 33 shows that matrix spike compound recovery from blowdown samples ranged from <40 to 70 percent. Naphthalene was not detected in either sample. Of 12 measurements, 6, or 50 percent, met the DQO of 50 to 150 percent.

Table 34 shows that matrix spike compound recoveries from kiln ash samples ranged from 55 to 82 percent for one sample, all within the DQO of 50 to 150 percent. Less than detectable recovery was experienced for all

TABLE 31. MATRIX SPIKE RECOVERIES FROM WASTE FEED SAMPLES

Spike compound	Test 4 (1-14-88)					Test 7 (1-27-88)				
	Spiked amount (mg)	Native amount[a] (mg)	Total (mg)	Analyzed amount (mg)	Recovery (%)	Spiked amount (mg)	Native amount[a] (mg)	Total (mg)	Analyzed amount (mg)	Recovery (%)
Naphthalene	33.4	68.0	101.4	110	108	33.9	<0.3	33.9	38	112
Acenaphthylene	30.0	16.0	46.0	51	111	28.5	<0.3	28.5	34	119
Fluorene	34.4	7.9	42.3	42	99	28.5	<0.3	28.5	30	105
Phenanthrene	30.9	28.0	58.9	55	93	34.3	<0.3	34.3	32	93
Anthracene	30.3	8.5	38.8	41	106	34.4	<0.3	34.4	36	105
Fluoranthene	34.4	13.0	47.4	36	76	31.2	<0.3	31.2	23	74

[a] From analysis of unspiked (native) waste sample.

TABLE 32. MATRIX SPIKE RECOVERIES FROM MM5 RESIN SAMPLES

Spike compound	Spike compound recovery (%)						
	Test 1 (12-9-87)	Test 2 (12-11-87)	Test 3 (12-17-87)	Test 4 (1-14-88)	Test 5 (1-20-88)	Test 7 (1-27-88)	Test 8 (1-29-88)
Naphthalene	66	62	66	64	66	68	78
Acenaphthylene	88	92	96	106	102	114	115
Fluorene	64	70	76	78	70	80	92
Phenanthrene	74	80	78	90	68	82	94
Anthracene	84	92	88	94	80	92	100
Fluoranthene	72	76	74	70	58	74	66

TABLE 33. MATRIX SPIKE RECOVERIES FROM BLOWDOWN LIQUOR SAMPLES

Spike compound	Spike compound recovery (%)	
	Test 5 (1-20-88)	Test 7 (1-27-88)
Naphthalene	<40	<40
Acenaphthylene	64	66
Fluorene	48	44
Phenanthrene	52	50
Anthracene	70	68
Fluoranthene	48	42

TABLE 34. MATRIX SPIKE RECOVERIES FROM KILN ASH SAMPLES

Spike compound	Spike compound recovery (%)	
	Test 5 (1-20-88)	Test 7 (1-27-88)
Naphthalene	<40	72
Acenaphthylene	<40	55
Fluorene	<40	76
Phenanthrene	<40	82
Anthracene	<40	72
Fluoranthene	<40	82

spike compounds in the other sample. Interestingly, surrogate recovery from both kiln ash matrix spike samples was comparable.

9.4 REPLICATE SAMPLING AND ANALYSIS

The test plan or QAPP specified that replicate MM5 train sampling of scrubber discharge flue gas be performed for four tests and that the two test conditions be replicated with simultaneous scrubber discharge flue gas and waste feed sampling. This replicate sampling was performed in an attempt to evaluate precision of the flue gas sampling/analysis method.

Results of this exercise are inconclusive. No POHC or other semivolatile organic hazardous constituent of interest was detected in any MM5 sample. Thus, the results of all replicate testing and sampling pairs were the same: no detectable POHC.

9.5 DATA QUALITY SUMMARY

During the course of this demonstration test program, several deviations from the test QAPP and test method-specified procedures occurred. These included:

- Failure to initially spike method surrogates into Tests 1, 2, and 3 waste feed, scrubber blowdown, and kiln ash samples, then subsequently spiking too low a level of surrogates into repeat waste feed samples
- Exceeding sampling extraction hold time limits for about 15 percent of the samples extracted and exceeding analysis hold time limits for roughly 40 percent of the samples analyzed including virtually all Test 1, 2, and 3 samples. The longest analysis hold time was 62 days versus a method requirement of 40 days.

The DQO's for surrogate recovery and matrix spike compound recovery were accomplished for waste feed and MM5 train sample analyses. However, these DQO's were not fully met for blowdown and kiln ash sample matrices.

Despite the above, the composition of all samples of a given matrix were comparable for all tests. Specifically, analysis results for all waste feed samples for the six tests in which the feed contained K087 waste were quite comparable; analysis results from waste feed samples which were not surrogate spiked were very similar to results from uncompromised samples. The composition of all MM5 train, blowdown, and kiln ash samples were comparable for all tests as well; no sample contained detectable levels of POHCs or any other Method 8270 constituent except bis(2-ethylhexyl)phthalate, which is a common laboratory contaminant.

The most important test measurements were those required to calculate POHC DRE. These required measurements of waste feed composition and MM5 train analysis results. As noted above, waste feed surrogate recovery met the DQO for those samples which were spiked. Matrix spike recovery from waste feed samples met the DQO. Waste feed analysis results for samples which were not surrogate spiked were very similar to those which were surrogate spiked.

Surrogate recovery from samples analyzed after hold time had expired was better than from samples analyzed within hold time limits. These analyses confirm that the QA descrepancies experienced did not detract from waste analysis data quality.

MM5 train surrogate recovery and matrix spike recovery met respective DQOs. Surrogate and matrix spike recoveries from samples analyzed after hold time had expired were no different than corrsponding recoveries for samples analyzed within hold time limits. Clearly, the hold time exceedences experienced did not detract from the MM5 train analysis data quality.

MM5 train surrogate recoveries, despite meeting the test program DQO, were low for some samples. However, test conclusions remain unchanged if calculated DREs are corrected for surrogate recovery.

Surrogate and matrix spike recoveries for kiln ash and scrubber blowdown samples did not meet respective DQO's as discussed in Sections 9.2 and 9.3. However, analysis hold time exceedences had no bearing on this. Despite the failure to meet DQOs, no POHC or other semivolatile organic priority pollutant (with the exception of bis(2-ethylhexyl) phthalate in kiln ash) was detected in any blowdown or kiln ash sample. Surrogate and matrix spike recoveries achieved suggest this is a warranted conclusion.

Test conclusions stated in Section 8 were based on analytical results as follows:

- No detectable POHC was measured in flue gas streams for any test with the result that greater than 99.99 percent POHC DRE was achieved for all tests
- No detectable POHC was measured in scrubber blowdown or kiln ash samples for any test

The QAPP and method deviations which occurred during these tests and the inability to achieve DQOs for blowdown and kiln ash analyses has no affect on the above test program conclusions. Sample-specific detection limits can be corrected for surrogate recovery with the effect of increasing them. POHCs were still not detected.

REFERENCES

1. Personal communication. J. Powers, EPA/OSWER, with L. Waterland, Acurex. July 1987.

2. Waterland, L. R., C. I. Okoh, and A. S. McElligott, SITE Program Applications Analysis Assessment of Superfund Applications for the American Combustion Inc. Pyretron Oxygen Enhanced. EPA/__/__/__. U.S. EPA, Cincinnati, Ohio. March 1989.

3. Harris, J. C., et al. Sampling and Analysis Methods for Hazardous Waste Incineration. EPA-600/8-84-002. February 1984.

4. Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846, 3rd ed. November 1986.

5. Code of Federal Regulations. Title 40, Part 60, Appendix A.

APPENDIX A

INCINERATOR OPERATING CONDITIONS LOG

Test : 24# Charge
Date : 12-08-87

Time	Scale Weight (lbs)	Kiln Temp (F)	Kiln Gas Flow (scfh)	kiln Air Flow (scfh)	Kiln Oxygen Flow (scfh)	Kiln Second Air DP (°wc)	AB Temp (F)	AB Gas Flow (scfh)	AB Air Flow (scfh)	AB Oxygen Flow (scfh)	Make-up Water cum. (gal)	Make-up Water rate (gpm)	Blowdown Water cum. (gal)	Blowdown Water rate (gpm)	Blowdown Water rate (gpm)	Water Evap. rate (gpm)	Venturi Scrubber Flow (gpm)
1015	1327.0	1850	420	11800	0	0	2024	380	10980	0	8951	—	7696	—	1.7	—	17
1030	1326.5	1727	220	6660	0	6	2032	500	14790	0	9009	3.9	7718	1.5	1.5	2.4	17
1045	1259.0	1730	220	6690	0	6	2035	520	15490	0	9073	4.3	7739	1.4	1.5	2.8	17
1100	1219.0	1714	220	6850	0	6	2030	570	17030	0	9151	5.2	7755	1.1	0.8	4.4	17
1115	1214.0	1820	220	6900	0	6	2034	490	14610	0	9209	3.9	7762	0.5	0.4	3.5	17
1130	1165.0	1734	220	6800	0	6	2008	570	16800	0	9267	3.9	7762	0.0	0.0	3.9	17
1145	1112.0	1891	230	7270	0	6	2050	440	13180	0	9322	3.7	7762	0.0	0.0	3.7	17
1200	1058.0	1737	230	7040	0	6	2009	470	13940	0	9387	4.3	7766	0.3	0.0	4.3	17
1215	1058.5	1808	230	7040	0	6	2011	380	11440	0	9457	4.7	7771	0.3	0.9	3.8	17
1230	1004.5	1955	220	6800	0	6	2059	550	16180	0	9526	4.6	7782	0.7	0.8	3.8	17
1245	978.0	1840	230	7070	0	6	2046	490	14760	0	9583	3.8	7792	0.7	0.8	3.0	17
1300	952.0	1892	230	6990	0	6	2022	530	15810	0	9658	5.0	7805	0.9	0.8	4.2	17
1315	911.0	1968	230	7450	0	6	2056	380	11120	0	9719	4.1	7815	0.7	0.8	3.3	17
1330	884.0	1767	220	6730	0	6	2003	530	15760	0	9791	4.8	7826	0.7	0.8	4.0	17
1345	830.5	2111	230	7080	0	6	2053	360	10450	0	9852	4.1	7836	0.7	0.8	3.3	17
1400	776.5	1900	220	6790	0	6	2031	570	16790	0	9926	4.9	7847	0.7	0.8	4.1	17
1415	776.5	2086	230	7360	0	6	2057	380	11330	0	9993	4.5	7857	0.7	0.8	3.7	17
1430	669.5	1969	220	6990	0	6	2043	540	15960	0	10062	4.6	7864	0.5	0.8	3.8	17
1445	670.0	1994	220	6270	0	6	2028	30	9050	0	10116	3.6	7873	0.6	0.5	3.1	17
1500	616.0	2013	210	6640	0	6	2037	320	9650	0	10200	5.6	7883	0.7	0.5	5.1	17
1515	567.0	2053	220	6830	0	6	2054	310	9630	0	10236	2.4	7887	0.3	0.5	1.9	17
1530	562.5	1918	210	6540	0	6	2017	530	15660	0	10309	4.9	7893	0.4	0.5	4.4	17
1545	536.0	1967	220	6980	0	6	2050	390	11500	0	10375	4.4	7898	0.3	0.5	3.9	17
1600	482.5	1826	210	6370	0	6	2053	410	1248	0	10435	4.0	7899	0.1	0.0	4.0	17
1615	442.0	1966	220	6650	0	6	2017	210	6340	0	10488	3.5	7905	0.4	0.5	3.0	17
1630	388.5	2032	220	7130	0	6	2065	360	10720	0	10559	4.7	7905	0.0	0.0	4.7	17
1645	388.5	2125	230	7280	0	6	2073	370	11110	0	10610	3.4	7912	0.5	0.5	2.9	17
1700	335.0	2031	140	3910	0	6	2062	380	11270	0	10692	5.5	7920	0.5	0.5	5.0	17
1715	308.0	2038	200	6480	0	6	2045	290	8660	0	10738	3.1	7925	0.3	0.5	2.6	17
1730	308.0	1778	200	6310	0	6	2019	610	18270	0	10810	4.8	7936	0.7	2.8	2.0	17
1745	308.0	1827	370	11730	0	0	2014	470	13800	0	10928	7.9	7987	3.4	2.8	5.1	17
1800	308.0	1861	380	11940	0	0	2022	500	14770	0	11042	7.6	8036	3.3	2.8	4.8	17

Test :   240 Charge
Date : 12-08-87

Time	Packed Column Flow (gpm)	Venturi DP ("wc)	Packed Column DP ("wc)	Liquor pH	ID Fan Inlet ("wc)	Kiln P ("wc)	AB Exit O2 (%)	AB Exit CO2 (%)	AB Exit CO (ppm)	AB Exit NOx (ppm)	AB Exit THC (ppm C	Kiln Exit O2 (%)	Kiln Exit CO2 (%)	Kiln Exit CO (ppm)	Kiln Exit THC (ppm C	Stack O2 (%)	Stack CO2 (%)	Stack CO (ppm)
1015	31	28	8	7.6	35	-0.03	6.6	9.0	—	90	0	9.5	6.4	30	0	14.0	—	0
1030	31	25	11	8.2	32	-0.03	6.2	6.1	—	90	0	10.0	5.2	30	0	12.5	—	0
1045	31	25	15	7.6	38	-0.04	10.0	3.6	—	80	0	15.0	6.8	30	0	15.0	—	0
1100	31	25	15	7.2	38	-0.03	5.0	8.5	—	125	0	7.5	10.0	30	0	13.5	—	0
1115	30	25	15	7.6	38	-0.04	9.0	5.3	—	80	0	8.0	8.8	40	0	14.5	—	0
1130	30	25	15	7.8	38	-0.03	4.8	7.8	—	120	0	10.0	10.0	40	0	12.0	—	0
1145	30	25	15	7.4	38	-0.05	9.8	5.2	—	80	0	13.0	7.8	40	0	15.0	—	0
1200	29	25	15	7.2	38	-0.04	5.2	8.7	—	110	0	7.5	10.0	50	0	12.5	—	0
1215	29	25	15	7.6	38	-0.07	9.0	8.3	—	85	0	13.5	5.7	40	0	15.0	—	0
1230	30	25	15	7.8	36	-0.03	4.0	10.0	—	125	0	6.5	9.7	70	0	13.0	—	0
1245	29	25	15	7.6	38	-0.05	8.5	5.3	—	95	0	15.0	8.0	50	0	14.5	—	0
1300	29	25	15	7.4	38	-0.03	0.5	10.0	—	90	0	5.0	9.6	60	0	12.5	—	0
1315	29	25	15	7.6	38	-0.05	7.5	9.0	—	100	0	10.2	7.2	40	0	14.5	—	0
1330	29	25	15	7.4	38	-0.01	4.0	10.0	—	100	0	7.5	9.0	60	0	14.0	—	0
1345	29	25	15	7.6	38	-0.09	8.0	8.4	—	110	0	12.5	6.2	40	0	13.5	—	0
1400	29	25	15	7.2	38	-0.02	5.0	10.0	—	110	0	5.2	10.3	70	0	12.5	—	0
1415	29	25	15	8.0	39	-0.03	7.5	10.0	—	110	0	7.6	8.2	50	0	13.5	—	0
1430	29	25	15	7.3	39	-0.03	4.2	10.0	—	115	0	3.5	10.4	60	0	12.0	—	0
1445	29	25	15	7.4	38	-0.06	9.0	8.4	—	90	0	12.5	5.9	50	0	15.0	—	0
1500	29	25	15	7.4	38	-0.04	7.5	8.4	—	120	0	12.5	6.0	40	0	14.0	—	0
1515	29	25	15	7.6	38	-0.03	7.8	9.0	—	100	0	10.5	6.5	50	0	14.5	—	0
1530	29	25	15	7.6	38	-0.03	5.0	10.0	—	125	0	5.0	9.7	70	0	12.5	—	0
1545	29	25	15	7.4	38	-0.05	7.5	8.4	—	110	0	10.4	6.3	40	0	14.5	—	0
1600	29	25	15	7.6	38	-0.05	5.4	10.0	—	125	0	5.0	9.3	70	0	12.5	—	0
1615	29	25	15	7.4	38	-0.05	11.0	10.0	—	75	0	11.5	4.8	40	0	16.5	—	0
1630	29	25	15	7.6	38	-0.03	5.0	10.0	—	130	0	5.0	9.6	80	0	11.5	—	0
1645	29	25	15	7.8	38	-0.05	5.0	10.0	—	120	0	7.5	7.0	60	0	13.5	—	0
1700	29	25	15	7.6	38	-0.06	7.6	8.4	—	85	0	10.4	5.9	40	0	15.0	—	0
1715	29	25	15	7.6	38	-0.05	7.8	7.6	—	110	0	10.2	5.2	40	0	24.5	—	0
1730	29	25	15	7.6	37	-0.02	8.0	8.6	—	95	0	12.5	5.6	40	0	14.0	—	0
1745	29	25	15	7.5	38	-0.07	7.5	8.8	—	75	0	11.0	6.5	40	0	14.5	—	0
1800	29	25	15	7.4	38	-0.06	8.0	8.6	—	75	0	11.0	6.1	40	0	14.5	—	0

Test : 210 Charge
Date : 12-09-87

Time	Scale Weight (lbs)	Kiln Temp (F)	Kiln Gas Flow (scfh)	Kiln Air Flow (scfh)	Kiln Oxygen Flow (scfh)	Kiln Second Air DP ("wc)	AB Temp (F)	AB Gas Flow (scfh)	AB Air Flow (scfh)	AB Oxygen Flow (scfh)	Make-up Water cum. (gal)	Make-up Water rate (gpm)	Blowdown Water cum. (gal)	Blowdown Water rate (gpm)	Blowdown Water rate (gpm)	Water Evap. rate (gpm)	Venturi Scrubber Flow (gpm)
1215	1056.5	1859	520	14770	0	0	2073	470	13350	0	7695	—	1018	—	3.0	—	17
1230	1032.5	1858	500	14320	0	0	2028	470	13330	0	7752	3.8	1039	1.4	0.5	3.3	17
1245	958.5	1867	250	7710	0	6	2044	550	16200	0	7787	2.3	1043	0.3	0.5	1.8	17
1300	1098.5	1683	230	7110	0	6	2010	440	12900	0	7836	3.3	1049	0.4	0.5	2.8	17
1315	1051.5	1566	220	6580	0	6	2000	600	17660	0	7915	5.3	1057	0.5	0.5	4.8	17
1330	1051.5	1769	230	7000	0	6	2041	630	18750	0	7978	4.2	1063	0.4	0.5	3.7	17
1345	1004.5	1695	220	6750	0	6	2074	520	15550	0	8064	5.7	1072	0.6	0.5	5.2	17
1400	957.5	1671	220	6830	0	6	2011	450	13510	0	8106	2.8	1074	0.1	0.0	2.8	17
1415	957.5	1653	210	6600	0	6	2020	630	18670	0	8189	5.5	1089	1.0	0.8	4.7	17
1430	933.5	1686	220	6620	0	6	2029	630	18680	0	8248	3.9	1099	0.7	0.8	3.1	17
1445	873.0	1879	220	6840	0	6	2055	470	13800	0	8317	4.6	1110	0.7	0.8	3.8	17
1500	873.0	1801	220	6830	0	6	2009	380	11200	0	8382	4.3	1120	0.7	0.8	3.5	17
1515	811.5	1736	220	6800	0	6	2022	630	18760	0	8464	5.5	1134	0.9	0.8	4.7	17
1530	801.5	1783	210	6410	0	6	2036	630	18600	0	8523	3.9	1143	0.6	0.8	3.1	17
1545	778.0	1842	230	7060	0	6	2018	370	11110	0	8598	5.0	1155	0.8	0.8	4.2	17
1600	731.5	1712	220	7090	0	6	1986	460	12590	0	8660	4.1	1165	0.7	0.8	3.3	17
1615	682.5	1725	220	6536	0	6	2025	630	18760	0	8739	5.3	1176	0.7	0.7	4.6	17
1630	684.0	1920	210	6630	0	6	2060	560	16660	0	8805	4.4	1185	0.6	0.7	3.7	17
1645	660.5	1868	220	6880	0	6	2032	370	10950	0	8872	4.5	1194	0.6	0.6	3.9	17
1700	613.5	1941	220	7080	0	6	2045	370	10890	0	8924	3.5	1201	0.5	0.6	2.9	17
1715	614.0	1811	220	6796	0	6	2037	630	18740	0	9011	5.8	1211	0.7	0.6	5.2	17
1730	614.0	1671	220	6570	0	6	2021	630	18620	0	9067	3.7	1224	0.9	0.3	3.4	17
1745	614.0	1844	460	14170	0	0	2012	430	12920	0	9184	7.8	1276	3.5	3.1	4.7	17
1800	614.0	1824	430	13050	0	0	2020	520	15340	0	9279	6.3	1320	2.9	3.1	3.2	17
1815	614.0	1852	450	13800	0	0	2049	520	15540	0	9382	6.9	1367	3.1	3.0	3.9	17

Test : 218 Charge
Date : 12-09-87

Time	Packed Column Flow (gpm)	Venturi DP ("wc)	Packed Column DP ("wc)	Liquor pH	ID Fan Inlet ("wc)	Kiln P ("wc)	AB Exit O2 (%)	AB Exit CO2 (%)	AB Exit CO (ppm)	AB Exit NOx (ppm)	AB Exit THC (ppm C	Kiln Exit O2 (%)	Kiln Exit CO2 (%)	Kiln Exit CO (ppm)	Kiln Exit THC (ppm C	Stack O2 (%)	Stack CO2 (%)	Stack CO (ppm)
1215	28	25	15	7.4	37	-0.05	7.5	8.4	—	80	20	11.5	5.6	0	0	14.0	—	0
1230	29	25	15	7.4	37	-0.05	8.0	8.0	—	75	20	12.5	5.2	0	0	14.5	—	0
1245	29	25	15	7.2	37	-0.02	5.5	9.8	—	120	20	11.0	6.9	10	0	12.5	—	0
1300	29	25	15	7.6	37	-0.03	10.5	7.2	—	75	20	15.2	3.9	20	0	16.0	—	0
1315	29	25	15	7.4	36	-0.03	7.0	10.0	—	75	20	6.0	7.0	10	0	15.0	—	0
1330	29	20	15	7.5	35	-0.03	7.0	9.9	—	100	20	11.0	7.1	10	0	13.7	—	0
1345	29	20	15	7.5	35	-0.04	10.0	7.8	—	95	20	15.5	4.1	20	0	15.0	—	0
1400	29	20	15	7.6	35	-0.03	7.5	9.6	—	80	20	12.5	7.5	50	0	15.0	—	0
1415	29	20	15	7.4	36	-0.03	5.0	10.0	—	100	20	10.0	8.8	10	0	12.5	—	0
1430	28	20	15	7.4	35	-0.03	7.5	9.6	—	110	20	12.5	8.3	10	0	12.5	—	0
1445	28	20	15	7.4	35	-0.05	7.5	9.0	—	100	20	12.5	6.4	10	0	13.0	—	0
1500	29	20	15	7.4	36	-0.03	10.0	7.8	—	60	20	15.0	4.7	10	0	15.5	—	0
1515	28	20	15	7.4	36	-0.04	5.0	10.0	—	85	20	10.0	9.1	10	0	13.0	—	0
1530	28	20	15	7.2	36	-0.03	4.8	10.0	—	90	20	7.5	10.0	20	0	13.5	—	0
1545	28	20	15	7.4	35	-0.04	10.0	7.6	—	66	20	15.0	4.7	10	0	16.0	—	0
1600	28	20	15	7.6	35	-0.04	10.0	8.0	—	65	20	15.0	4.9	10	0	13.0	—	0
1615	28	20	15	7.3	36	-0.03	2.5	10.0	—	80	20	7.5	8.7	10	0	11.5	—	0
1630	28	20	15	7.6	36	-0.03	5.2	10.0	—	95	20	9.8	8.8	20	0	12.0	—	0
1645	28	20	15	7.3	35	-0.03	10.0	7.8	—	60	20	15.0	4.7	10	0	15.5	—	0
1700	28	20	15	7.4	36	-0.03	10.0	7.6	—	65	20	15.0	4.7	10	0	15.0	—	0
1715	28	20	15	7.2	36	-0.03	5.0	10.0	—	90	20	7.5	8.7	10	0	12.5	—	0
1730	28	20	15	7.6	36	-0.03	8.0	8.8	—	75	20	15.0	5.1	0	0	14.0	—	0
1745	28	20	15	7.4	36	-0.11	8.0	9.0	—	55	20	12.0	6.3	0	0	14.0	—	0
1800	28	20	15	7.6	36	-0.08	8.0	8.8	—	60	20	12.5	6.2	0	0	14.0	—	0
1815	28	20	15	7.4	36	-0.09	8.0	8.6	—	60	20	13.0	5.9	0	0	14.0	—	0

Test :   210 Charge
Date : 12-11-87

Time	Scale Weight (lbs)	Kiln Temp (F)	Kiln Gas Flow (scfh)	Kiln Air Flow (scfh)	Kiln Oxygen Flow (scfh)	Kiln Second Air DP ("wc)	AB Temp (F)	AB Gas Flow (scfh)	AB Air Flow (scfh)	AB Oxygen Flow (scfh)	Make-up Water cum. (gal)	Make-up Water rate (gpm)	Blowdown Water cum. (gal)	Blowdown Water rate (gpm)	Blowdown Water rate (gpm)	Water Evap. rate (gpm)	Venturi Scrubber Flow (gpm)
1100	614.5	1868	420	11480	0	0	2021	330	9530	0	8951	—	8257	—	0.5	—	16
1115	614.5	1568	280	8560	0	0	1984	580	15390	0	8989	2.5	8261	0.3	0.5	2.0	16
1130	568.0	1590	280	8600	0	6	1991	580	17320	0	9024	2.3	8266	0.3	0.5	1.8	16
1145	521.5	1770	230	7080	0	6	2055	540	16080	0	9109	5.7	8274	0.5	0.5	5.2	16
1200	474.5	1678	240	7240	0	6	2026	460	13790	0	9171	4.1	8280	0.4	0.5	3.6	16
1215	474.5	1732	230	2170	0	6	2025	500	14830	0	9224	3.5	8286	0.4	0.5	3.0	16
1230	427.5	1583	240	6950	0	6	1995	600	17580	0	9296	4.8	8292	0.4	0.5	4.3	16
1245	380.5	1708	220	6860	0	6	2027	630	18670	0	9354	3.9	8293	0.1	0.0	3.9	16
1300	380.5	1872	220	7080	0	6	2059	540	15880	0	9416	4.1	8299	0.4	0.5	3.6	16
1315	333.0	1680	230	7260	0	6	1984	480	14140	0	9488	4.8	8306	0.5	0.5	4.3	16
1330	333.0	1692	230	7020	0	6	2022	630	18710	0	9560	4.8	8312	0.4	0.5	4.3	16
1345	286.0	1913	220	6530	0	6	2051	620	18340	0	9619	3.9	8317	0.3	0.5	3.4	16
1400	238.5	1866	230	7120	0	6	2038	410	12290	0	9688	4.6	8323	0.4	0.5	4.1	16
1415	238.5	1725	230	7120	0	6	1991	50	14570	0	9750	4.1	8329	0.4	0.5	3.6	16
1430	191.5	1724	230	6990	0	6	1999	570	16880	0	9814	4.3	8334	0.3	0.5	3.8	16
1445	263.0	1702	220	6700	0	6	2041	630	18630	0	9880	4.4	8339	0.3	0.5	3.9	16
1500	216.0	1656	230	6940	0	6	2038	590	17660	0	9933	3.5	8343	0.3	0.5	3.0	16
1515	216.0	1544	220	6920	0	6	2021	60	17760	0	10010	5.1	8351	0.5	0.5	4.6	16
1530	168.5	1542	220	7060	0	6	2023	600	17960	0	10067	3.8	8358	0.5	0.5	3.3	16
1545	121.0	1616	220	6740	0	6	2024	630	18560	0	10136	4.6	8360	0.1	0.0	4.6	16
1600	144.5	1667	220	6780	0	6	2040	620	18510	0	10204	4.5	8371	0.7	0.8	3.7	16
1615	144.5	1856	510	15520	0	0	2014	430	12710	0	10275	4.7	8382	0.7	0.8	3.9	16
1630	144.5	1870	480	14940	0	0	2021	510	1510	0	10396	8.1	8438	3.7	3.0	5.1	16
1645	144.5	1860	470	14590	0	0	2022	510	15190	0	10493	6.5	8482	2.9	3.0	3.5	16

Test : 21# Charge
Date : 12-11-87

Time	Packed Column Flow (gpm)	Venturi DP ("wc)	Packed Column DP ("wc)	Liquor pH	ID Fan Inlet ("wc)	Kiln P ("wc)	AB Exit O2 (%)	AB Exit CO2 (%)	AB Exit CO (ppm)	AB Exit NOx (ppm)	AB Exit THC (ppm C	Kiln Exit O2 (%)	Kiln Exit CO2 (%)	Kiln Exit CO (ppm)	Kiln Exit THC (ppm C	Stack O2 (%)	Stack CO2 (%)	Stack CO (ppm)
1100	29	30	3	7.6	32	-0.03	6.0	9.0	—	101	0	10.0	5.9	20	0	10.0	—	0
1115	30	23	14	7.4	35	-0.10	10.0	7.2	—	101	0	13.0	4.0	80	0	12.5	—	0
1130	30	21	15	7.4	35	-0.03	9.8	8.6	—	101	0	7.5	5.7	20	0	12.5	—	0
1145	29	20	15	7.4	34	-0.04	9.5	8.0	—	125	0	13.5	4.5	30	0	11.0	—	0
1200	29	20	15	7.6	34	-0.06	10.5	7.3	—	115	0	13.5	4.7	30	0	13.0	—	0
1215	29	20	15	7.4	34	-0.05	10.0	7.8	—	110	0	14.0	4.8	20	0	12.5	—	0
1230	29	20	15	7.5	34	-0.04	5.5	10.0	—	110	0	9.0	8.1	40	0	11.0	—	0
1245	29	20	15	7.4	34	-0.03	5.0	10.0	—	145	0	5.0	11.5	90	0	10.0	—	0
1300	30	20	15	7.4	35	-0.05	5.0	10.0	—	150	0	10.0	8.2	30	0	10.5	—	0
1315	30	20	15	7.4	35	-0.05	9.0	8.5	—	125	0	14.0	5.2	20	0	12.5	—	0
1330	30	20	15	7.4	35	-0.03	4.0	10.0	—	145	0	6.0	10.7	40	0	10.5	—	0
1345	30	20	15	7.5	35	-0.04	4.5	10.0	—	155	0	10.0	7.7	20	0	10.5	—	0
1400	29	20	15	7.6	35	-0.09	9.0	8.0	—	125	0	13.0	5.7	20	0	13.0	—	0
1415	29	20	15	7.4	35	-0.06	10.0	8.2	—	120	0	14.0	5.2	20	0	13.0	—	0
1430	29	20	15	7.5	35	-0.03	5.0	10.0	—	120	0	10.0	9.0	20	0	11.0	—	0
1445	29	20	15	7.6	35	-0.04	8.0	8.4	—	120	0	13.0	5.2	20	0	12.0	—	0
1500	29	20	15	7.2	35	-0.04	8.0	8.2	—	110	0	13.0	5.0	50	0	12.5	—	0
1515	29	20	15	7.4	35	-0.05	10.0	7.8	—	110	0	15.0	4.3	80	0	12.5	—	0
1530	29	20	15	7.5	35	-0.04	7.5	9.8	—	100	0	11.5	6.7	20	0	11.5	—	0
1545	29	20	15	7.5	35	-0.04	8.0	8.2	—	125	0	15.0	5.0	20	0	12.0	—	0
1600	29	20	15	7.5	35	-0.04	7.5	8.4	—	120	0	8.0	4.8	40	0	12.0	—	0
1615	29	20	15	7.4	35	-0.09	7.5	8.6	—	100	0	10.0	6.6	10	0	12.0	—	0
1630	29	20	15	7.5	35	-0.09	8.0	8.2	—	95	0	11.0	6.3	0	0	12.0	—	0
1645	29	20	15	7.6	35	-0.09	8.0	8.4	—	90	0	11.5	6.2	0	0	12.0	—	0

Test : 21# Charge
Date : 12-17-87

Time	Scale Weight (lbs)	Kiln Temp (F)	Kiln Gas Flow (scfh)	Kiln Air Flow (scfh)	Kiln Oxygen Flow (scfh)	Kiln Second Air DP ("wc)	AB Temp (F)	AB Gas Flow (scfh)	AB Air Flow (scfh)	AB Oxygen Flow (scfh)	Make-up Water cum. (gal)	Make-up Water rate (gpm)	Blowdown Water cum. (gal)	Blowdown Water rate (gpm)	Blowdown Water rate (gpm)	Water Evap. rate (gpm)	Venturi Scrubber Flow (gpm)
1000	697.5	1853	350	5080	1900	0	2021	340	8150	910	4005	—	3285	—	2.4	---	16a
1015	697.5	1854	340	8530	1800	0	2027	350	8510	960	4081	5.1	3312	1.8	2.4	2.7	16a
1030	697.5	1858	330	8550	1820	0	2032	330	8110	910	4140	3.9	3343	2.1	2.2	1.7	16a
1045	698.0	1878	470	8840	3030	2	2033	330	8130	940	4186	3.1	3367	1.6	2.0	1.1	16a
1100	650.0	1732	170	6150	1260	2	2039	460	10920	1240	4220	2.3	3377	0.7	0.8	1.5	16a
1115	601.5	1683	160	5770	1300	2	2025	420	9930	1150	4272	3.5	3388	0.7	0.8	2.7	16a
1130	601.5	1685	170	5920	3220	2	2019	400	9650	2510	4320	3.2	3399	0.7	0.8	2.4	16a
1145	554.0	1824	170	6100	2980	2	2015	390	9470	2530	4369	3.3	3409	0.7	0.8	2.5	16a
1200	554.0	1799	170	5980	1310	2	2021	390	9560	1250	4403	2.3	3420	0.7	0.8	1.5	16a
1215	506.5	1786	160	6130	1310	2	2023	390	9450	1070	4476	4.9	3432	0.8	0.8	4.1	16a
1230	458.5	1867	140	5800	3180	2	2021	370	9030	2500	4521	3.0	3442	0.7	0.8	2.2	16a
1245	411.0	1977	150	5890	1180	2	2036	360	8600	960	4569	3.2	3454	0.8	0.8	2.4	16a
1300	411.0	1888	150	5820	1180	2	2034	440	10520	1190	4613	2.9	3462	0.5	0.8	2.1	16a
1315	363.5	1908	150	5780	2930	2	2022	450	10780	2510	4687	4.9	3480	1.2	0.8	4.1	16a
1330	316.0	1884	140	5800	3100	2	2006	350	8560	2520	4728	2.7	3489	0.6	0.8	1.9	16a
1345	316.0	1941	140	5760	1200	2	2039	300	7520	8300	4773	3.0	3500	0.7	0.8	2.2	16a
1400	268.0	1960	150	5590	1210	3	2023	360	8610	970	4825	3.5	3512	0.8	0.8	2.7	16a
1415	268.0	1849	140	5520	1190	3	2018	360	8680	980	4881	3.7	3525	0.9	0.8	2.9	16a
1430	220.0	1949	130	5400	2930	3	2023	380	8970	2520	4929	3.2	3536	0.7	0.8	2.4	16a
1445	220.0	1988	130	5590	1650	3	2023	340	8370	9500	4971	2.8	3545	0.6	0.8	2.0	16a
1500	172.5	1818	130	5590	1210	3	2007	300	7540	8500	5052	5.4	3564	1.3	0.8	4.6	16a
1515	124.5	1862	140	5640	1280	3	2008	290	7320	8000	5078	1.7	3570	0.4	0.8	0.9	16a
1530	100.5	1900	150	5690	3130	3	2013	460	10810	2510	5135	3.8	3582	0.8	0.8	3.0	16a
1545	100.5	2042	140	5730	1660	3	2018	330	7960	1360	5184	3.3	3594	0.8	0.8	2.5	16a
1600	100.5	1880	140	5630	1230	0	2040	380	9240	1050	5243	3.9	3605	0.7	0.8	3.1	16a
1615	100.5	1840	186	6360	1300	0	2024	370	9060	1020	5287	2.9	3619	0.9	0.8	2.1	16a
1630	100.5	1867	220	6670	1440	0	2032	370	8970	1010	5324	2.5	3630	0.7	0.8	1.7	16a

Test : 210 Charge
Date : 12-17-87

Time	Packed Column Flow (gpm)	Venturi DP ("wc)	Packed Column DP ("wc)	Liquor pH	ID Fan Inlet ("wc)	Kiln P ("wc)	AB Exit O2 (%)	AB Exit CO2 (%)	AB Exit CO (ppm)	AB Exit NOx (ppm)	AB Exit THC (ppm C	Kiln Exit O2 (%)	Kiln Exit CO2 (%)	Kiln Exit CO (ppm)	Kiln Exit THC (ppm C	Stack O2 (%)	Stack CO2 (%)	Stack CO (ppm)
1000	30	30	5	7.5	30	-0.05	13.5	10.0	—	1950	0	19.0	6.1	40	0	16.0	—	0
1015	30	30	9	7.4	34	-0.04	14.0	10.0	—	2150	0	22.0	6.0	30	0	16.5	—	4
1030	30	30	9	7.5	34	-0.04	14.0	10.0	—	2150	0	21.5	5.7	30	0	16.5	—	6
1045	30	30	10	7.6	32	-0.03	15.0	10.0	—	1850	0	23.0	5.5	20	0	17.0	—	3
1100	30	30	9	7.4	33	-0.03	20.5	10.0	—	2100	0	20.0	5.2	100	0	19.5	—	4
1115	30	30	9	7.5	33	-0.04	18.0	10.0	—	1800	0	21.5	6.8	40	0	19.0	—	5
1130	30	30	11	7.5	32	-0.03	16.0	10.0	—	2050	0	17.5	11.0	30	0	18.5	—	5
1145	30	30	10	7.5	33	-0.04	13.5	10.0	—	1750	0	15.0	9.1	40	0	17.5	—	6
1200	30	30	11	7.6	33	-0.04	13.0	10.0	—	2000	0	16.0	10.1	30	0	16.5	—	6
1215	30	30	11	7.6	35	-0.05	16.5	10.0	—	2000	0	15.0	12.4	30	0	16.5	—	14
1230	30	30	11	7.5	31	-0.02	15.5	10.0	—	1950	0	16.0	10.2	20	0	17.5	—	14
1245	30	30	11	7.8	31	-0.06	11.0	10.0	—	1050	0	13.5	8.1	20	0	15.0	—	16
1300	30	30	12	7.4	32	-0.04	11.0	10.0	—	1150	0	14.0	9.9	20	0	14.0	—	16
1315	30	30	13	7.3	32	-0.02	15.0	10.0	—	2000	0	17.5	11.3	30	0	16.5	—	17
1330	30	30	14	7.6	32	-0.03	18.0	10.0	—	1950	0	17.5	10.4	40	0	18.5	—	18
1345	30	30	13	7.4	32	-0.05	11.5	10.0	—	1200	0	15.0	8.7	50	0	15.0	—	18
1400	30	30	14	8.0	32	-0.05	12.5	10.0	—	1150	0	16.0	7.9	40	0	15.0	—	20
1415	30	30	10	7.4	33	-0.02	18.0	10.0	—	1800	0	20.0	10.6	40	0	19.5	—	20
1430	30	30	10	7.3	33	-0.02	17.5	10.0	—	1800	0	17.5	11.8	40	0	17.5	—	20
1445	30	30	10	7.3	33	-0.03	17.5	10.0	—	1850	0	18.0	13.6	40	0	17.5	—	22
1500	30	30	10	7.2	32	-0.01	13.0	10.0	—	1900	0	16.5	13.3	50	0	17.5	—	22
1515	30	30	10	7.2	32	-0.05	18.0	10.0	—	1800	0	21.0	10.7	40	0	19.0	—	22
1530	30	30	11	8.0	32	-0.01	15.5	10.0	—	2000	0	19.0	11.3	40	0	17.0	—	24
1545	30	30	11	7.8	32	-0.03	12.5	10.0	—	1100	0	15.5	8.4	40	0	15.5	—	25
1600	30	30	9	7.6	34	-0.06	14.0	10.0	—	1500	0	19.5	6.4	30	0	16.5	—	26
1615	30	30	9	7.4	34	-0.06	14.0	10.0	—	1650	0	19.0	6.2	30	0	16.5	—	27
1630	30	30	9	7.6	34	-0.05	14.0	10.0	—	1700	0	22.0	5.9	30	0	16.5	—	30

Test : 340 Charge
Date : 1-14-88

Time	Scale Weight (lbs)	Kiln Temp (F)	Kiln Gas Flow (scfh)	Kiln Air Flow (scfh)	Kiln Oxygen Flow (scfh)	Kiln Second Air DP ("wc)	AB Temp (F)	AB Gas Flow (scfh)	AB Air Flow (scfh)	AB Oxygen Flow (scfh)	Make-up Water cum. (gal)	Make-up Water rate (gpm)	Blowdown Water cum. (gal)	Blowdown Water rate (gpm)	Blowdown Water rate (gpm)	Water Evap. rate (gpm)	Venturi Scrubber Flow (gpm)
1300	780.0	1876	510	11910	1080	0	2016	450	10620	950	8080	—	5027	—	0.8	—	17
1315	732.0	1754	170	6240	4050	3	2025	490	11610	2510	8145	4.3	5036	0.6	0.7	3.6	17
1330	699.0	1700	280	8110	1700	3	2016	430	10300	1150	8212	4.5	5046	0.7	0.7	3.8	17
1345	626.0	1763	190	6430	3980	3	2008	460	10820	2490	8270	3.9	5057	0.7	0.6	3.3	17
1400	626.0	1716	340	8790	1870	3	2012	460	10880	1220	8314	2.9	5064	0.5	0.6	2.3	17
1415	589.5	1681	250	7760	1540	3	2013	480	11220	1250	8371	3.8	5072	0.5	0.6	3.2	17
1430	553.0	1786	170	6270	4050	2	2013	460	10770	2380	8438	4.5	5082	0.7	0.6	3.9	17
1445	516.5	1681	180	6956	3550	2	2003	460	10780	2520	8497	3.9	5091	0.6	0.6	3.3	17
1500	516.5	1822	330	4020	1860	2	2018	390	9410	1060	8555	3.9	5100	0.6	0.6	3.3	17
1515	479.5	1758	190	6730	1560	1	2013	360	8640	9500	8613	3.9	5109	0.6	0.6	3.3	17
1530	442.5	1923	170	6240	3550	1	2018	450	10600	2500	8669	3.7	5117	0.5	0.6	3.1	17
1545	405.0	1872	170	6206	3500	1	2008	450	10600	2520	8740	4.7	5129	0.8	0.6	4.1	17
1600	368.5	1874	170	6330	3470	1	2008	460	10920	2510	8821	5.4	5142	0.9	0.6	4.8	17
1615	368.5	1750	270	8010	1620	1	1998	540	12510	1420	8862	2.7	5148	0.4	0.6	2.1	17
1630	331.5	1751	180	6160	3550	1	2020	400	9690	2090	8910	3.2	5157	0.6	0.6	2.6	17
1645	299.5	1787	170	6320	3440	1	2015	500	11610	2460	8980	4.7	5168	0.7	0.6	4.1	17
1700	294.5	1770	280	8020	1660	1	2022	540	12600	1420	9038	3.9	5177	0.6	0.6	3.3	17
1715	258.0	1775	260	7630	1550	1	2011	500	11610	1320	9108	4.7	5189	0.8	0.6	4.1	17
1730	221.5	1827	160	6120	1290	1	2025	430	10290	1150	9169	4.1	5199	0.7	0.6	3.5	17
1745	184.0	1726	190	6670	3470	1	2004	490	11410	2030	9230	4.1	5209	0.7	0.6	3.5	17
1800	147.5	1741	170	5820	3600	1	2016	470	11230	2500	9291	4.1	5218	0.6	0.7	3.4	17
1815	141.5	1820	290	8050	1650	0	2017	540	12540	1420	9358	4.5	5229	0.7	0.7	3.8	17
1830	147.5	1804	270	7820	1610	0	2021	420	10120	1150	9417	3.9	5238	0.6	0.7	3.2	17
1845	147.5	1805	300	8200	1680	0	2013	480	11300	1270	9473	3.7	5248	0.7	0.7	3.0	17

Test : 340 Charge
Date : 1-14-88

Time	Packed Column Flow (gpm)	Venturi DP ("wc)	Packed Column DP ("wc)	Liquor pH	ID Fan Inlet ("wc)	Kiln P ("wc)	AB Exit O2 (%)	AB Exit CO2 (%)	AB Exit CO (ppm)	AB Exit NOx (ppm)	AB Exit THC (ppm C	Kiln Exit O2 (%)	Kiln Exit CO2 (%)	Kiln Exit CO (ppm)	Kiln Exit THC (ppm C	Stack O2 (%)	Stack CO2 (%)	Stack CO (ppm)
1300	30	28	6	7.4	20	-0.13	16.0	—	—	1450	0	14.5	—	4	0	16.0	5.1	0
1315	30	28	6	6.9	36	-0.02	22.5	—	—	700	0	18.5	—	3	0	18.5	6.6	10
1330	30	25	6	7.4	36	-0.02	14.5	—	—	1000	0	13.0	—	4	0	15.5	6.4	10
1345	30	25	6	7.1	35	-0.03	15.5	—	—	900	0	15.5	—	10	0	17.0	8.7	10
1400	30	25	6	7.2	35	-0.05	15.0	—	—	1300	0	14.0	—	4	0	15.2	6.1	0
1415	30	25	6	7.1	34	-0.05	13.5	—	—	1050	0	13.0	—	4	0	16.0	6.7	10
1430	30	25	6	7.8	34	-0.08	11.0	—	—	750	0	12.0	—	4	0	14.0	7.4	0
1445	30	25	6	7.1	34	-0.04	14.5	—	—	1150	0	15.0	—	7	0	16.0	6.9	0
1500	30	25	6	7.4	33	-0.07	14.0	—	—	1450	0	13.5	—	1	0	15.0	6.3	0
1515	30	25	6	7.2	32	-0.09	14.0	—	—	1000	0	14.0	—	0	0	15.5	5.8	0
1530	30	25	6	6.8	32	-0.05	15.0	—	—	950	0	15.5	—	1	0	17.5	3.8	0
1545	30	25	6	6.8	31	-0.04	12.0	—	—	900	0	15.0	—	0	0	20.0	0.1	0
1600	30	25	6	7.1	31	-0.04	13.0	—	—	950	0	14.5	—	0	0	18.0	0.1	0
1615	30	25	6	7.1	30	-0.06	15.0	—	—	1300	0	14.0	—	18	0	15.0	6.4	20
1630	30	25	6	7.4	30	-0.08	14.5	—	—	750	0	15.0	—	17	0	14.5	6.7	180
1645	30	25	6	7.0	30	-0.04	12.0	—	—	950	0	14.0	—	16	0	16.0	9.5	0
1700	30	25	6	7.8	30	-0.06	15.0	—	—	1300	0	15.0	—	28	0	16.5	6.4	0
1715	30	25	6	7.0	30	-0.06	14.0	—	—	1400	0	14.0	—		0	15.0	9.9	0
1730	30	25	6	7.0	30	-0.06	14.0	—	—	800	0	13.0	—	4	0	15.0	5.7	0
1745	30	25	6	7.0	30	-0.06	14.5	—	—	950	0	14.5	—	0	0	15.0	7.4	0
1800	30	25	6	7.4	30	-0.06	17.5	—	—	950	0	17.0	—	0	0	17.5	7.6	0
1815	30	25	6	7.9	30	-0.09	17.5	—	—	1200	0	17.5	—	0	0	15.0	6.3	0
1830	30	25	6	7.1	30	-0.11	15.5	—	—	1200	0	15.0	—	0	0	16.5	6.2	0
1845	30	25	6	7.6	30	-0.11	15.5	—	—	1200	0	15.0	—	0	0	16.8	6.0	0

Test : 21# Charge
Date : 1-20-88

Time	Scale Weight (lbs)	Kiln Temp (F)	Kiln Gas Flow (scfh)	Kiln Air Flow (scfh)	Kiln Oxygen Flow (scfh)	Kiln Second Air DP ("wc)	AB Temp (F)	AB Gas Flow (scfh)	AB Air Flow (scfh)	AB Oxygen Flow (scfh)	Make-up Water cum. (gal)	Make-up Water rate (gpm)	Blowdown Water cum. (gal)	Blowdown Water rate (gpm)	Blowdown Water rate (gpm)	Water Evap. rate (gpm)	Venturi Scrubber Flow (gpm)
1500	1744.0	1864	450	10490	2180	3	2005	460	10800	1210	7070	—	542	—	2.4	—	16
1515	1696.5	1796	200	6050	2940	3	2017	590	13700	2150	7158	5.9	564	1.5	0.5	5.4	16
1530	1649.0	1713	170	6300	2930	3	1991	420	9900	2490	7207	3.3	570	0.4	0.5	2.8	16
1545	1625.0	1757	420	10150	2900	3	2003	530	12310	2520	7279	4.8	578	0.5	0.5	4.3	16
1600	1554.0	1741	160	6000	2950	3	2011	460	11010	2520	7337	3.9	585	0.5	0.5	3.4	16
1615	1483.0	1792	160	6030	3010	3	2007	430	10320	2480	7395	3.9	591	0.4	0.5	3.4	16
1630	1363.5	1725	170	6080	3090	3	2003	410	9740	2510	7460	4.3	598	0.5	0.5	3.8	16
1645	1363.5	1823	170	6230	2980	3	2024	430	10120	1990	7525	4.3	604	0.4	0.5	3.8	16
1700	1316.0	1818	160	6060	3070	3	2005	430	10310	2520	7592	4.5	610	0.4	0.2	4.3	16
1715	1269.0	1912	170	6030	3040	4	2026	490	11220	1960	7656	4.3	615	0.3	0.5	3.8	16
1730	1198.0	1840	170	6240	2890	4	2013	460	10920	2520	7717	4.1	624	0.6	0.7	3.4	16
1745	1126.0	1926	170	6260	3070	4	2006	400	9430	2510	7782	4.3	635	0.7	0.7	3.6	16
1800	1102.0	1780	160	5890	1160	4	2015	380	9250	105	7851	4.6	647	0.8	0.7	3.9	16
1815	1030.5	1733	250	7720	3030	4	2008	480	11350	2510	7910	3.9	657	0.7	0.7	3.2	16
1830	983.5	1780	170	6160	3110	4	2016	450	10670	2520	7981	4.7	669	0.8	0.7	4.0	16
1845	911.5	1842	160	6420	2910	4	2023	430	10330	2510	8082	6.7	686	1.1	0.7	6.0	16
1900	886.5	1848	170	6250	2900	4	2013	430	9560	2490	8117	2.3	691	0.3	0.7	1.6	16
1915	814.0	1727	170	6290	3020	4	2010	460	10200	2510	8185	4.5	702	0.7	0.7	3.8	16
1930	766.5	1837	170	6060	2970	4	2002	400	8930	2500	8247	4.1	713	0.7	0.7	3.4	16
1945	719.0	1781	160	6070	2850	4	1993	400	8650	2510	8311	4.3	725	0.8	0.7	3.6	16
2000	623.5	1732	180	6680	3120	4	1997	410	9010	2510	8375	4.3	735	0.7	0.7	3.6	16
2015	527.5	1837	170	6100	3130	4	2006	440	9530	2500	8454	5.3	747	0.8	0.7	4.6	16
2030	527.5	1755	170	6100	2860	4	2006	430	9510	2500	8507	3.5	755	0.5	0.7	2.8	16
2045	456.0	1745	170	6090	2980	4	2015	450	9730	2500	8581	4.9	766	0.7	0.7	4.2	16
2100	394.5	1861	170	6240	2910	4	2030	440	9620	2510	8639	3.9	774	0.5	0.7	3.2	16
2115	431.5	1859	220	7040	1470	0	2009	440	9590	1320	8727	5.9	784	0.7	0.7	5.2	16
2130	431.5	1863	220	6850	1440	0	2020	446	9730	1360	8766	2.6	791	0.5	0.7	1.9	16
2145	431.5	1854	210	6870	1470	0	2010	410	8930	1250	8818	3.5	800	0.6	0.7	2.8	16

Test : 210 Charge
Date : 1-20-88

Time	Packed Column Flow (gpm)	Venturi DP ("wc)	Packed Column DP ("wc)	Liquor pH	ID Fan Inlet ("wc)	Kiln P ("wc)	AB Exit O2 (%)	AB Exit CO2 (%)	AB Exit CO (ppm)	AB Exit NOx (ppm)	AB Exit THC (ppm C	Kiln Exit O2 (%)	Kiln Exit CO2 (%)	Kiln Exit CO (ppm)	Kiln Exit THC (ppm C	Stack O2 (%)	Stack CO2 (%)	Stack CO (ppm)
1500	26	25	6	7.2	23	-0.05	16.0	6.5	0.0	150	—	14.5	6.9	4	0	15.0	5.8	0.0
1515	26	25	6	7.4	23	-0.07	16.0	9.0	0.0	100	—	14.5	10.3	17	0	16.0	7.4	0.0
1530	26	25	6	7.8	23	-0.03	10.0	10.5	0.0	1200	—	14.0	14.5	71	0	15.5	8.9	0.0
1545	26	25	6	7.2	23	-0.03	17.0	8.7	0.0	1600	—	15.0	10.1	35	0	16.0	7.0	0.0
1600	26	25	6	7.1	23	-0.04	16.0	10.8	1.5	1250	—	15.5	14.4	56	0	16.0	8.1	0.0
1615	26	25	6	7.0	23	-0.03	15.0	9.2	4.5	1100	—	15.5	11.7	61	0	13.0	7.6	0.3
1630	26	25	6	6.8	23	-0.04	17.0	8.8	0.0	1350	—	16.0	12.4	82	0	16.5	7.2	0.0
1645	26	25	6	6.4	23	-0.10	12.5	12.0	0.2	1200	—	12.0	16.7	64	0	16.0	8.2	0.0
1700	26	25	6	7.2	23	-0.01	12.0	8.8	10.8	0	—	17.0	16.0	76	0	16.0	8.0	0.0
1715	26	25	6	7.4	22	-0.04	13.5	9.3	5.5	0	—	15.5	14.7	66	0	16.5	7.8	0.1
1730	26	25	6	6.8	22	-0.01	12.0	10.9	2.5	0	—	15.0	17.3	50	0	15.5	9.1	0.1
1745	26	25	6	7.6	22	-0.02	14.0	9.2	0.0	0	—	15.0	12.2	61	0	15.0	8.1	0.1
1800	26	25	6	7.0	22	0.00	14.5	7.2	12.5	0	—	14.5	10.2	76	0	15.0	6.5	0.1
1815	26	25	6	6.8	22	0.00	10.5	9.8	2.7	0	—	13.5	12.8	75	0	15.0	9.0	0.1
1830	26	25	7	6.6	22	-0.04	15.0	9.8	2.1	0	—	15.5	12.6	80	0	15.5	8.5	0.1
1845	26	25	7	6.8	22	-0.04	13.0	9.6	0.4	0	—	15.0	14.0	67	0	16.0	8.9	0.1
1900	26	25	7	6.8	22	-0.02	11.5	9.4	9.7	0	—	14.0	13.2	83	0	15.0	7.5	0.1
1915	26	25	7	6.6	22	-0.02	12.5	9.7	1.7	0	—	14.0	15.1	87	0	15.5	8.8	0.1
1930	26	25	7	7.2	22	-0.01	10.5	9.8	9.4	0	—	14.0	12.6	73	0	15.0	9.1	0.1
1945	26	25	7	7.4	22	-0.03	14.5	8.8	2.3	0	—	15.5	13.9	68	0	16.5	8.2	0.1
2000	26	25	7	7.2	21	-0.02	15.0	8.3	9.3	0	—	16.0	13.2	98	0	16.5	7.8	0.1
2015	26	25	8	7.7	21	-0.02	13.0	10.3	1.4	400	—	15.0	16.2	67	0	15.5	8.8	0.1
2030	26	25	8	7.2	21	-0.01	14.0	8.7	2.5	750	—	16.0	13.0	82	0	16.0	9.3	0.1
2045	26	25	8	6.8	20	-0.01	12.5	8.6	2.5	560	—	15.0	12.9	75	0	16.0	8.5	0.1
2100	26	25	8	6.4	20	-0.03	12.5	8.8	2.7	450	—	14.5	13.5	70	0	16.0	8.9	0.1
2115	26	25	6	6.6	24	-0.15	14.0	7.3	9.1	400	—	13.0	8.0	27	0	15.0	6.8	0.1
2130	26	25	6	7.0	24	-0.12	15.0	7.2	10.1	400	—	13.5	7.5	12	0	15.0	6.7	0.1
2145	27	25	6	7.6	24	-0.11	15.0	6.7	12.4	350	—	14.5	6.9	8	0	15.5	6.4	0.1

Test : 21# Charge
Date : 1-21-88

Time	Scale Weight (lbs)	Kiln Temp (F)	Kiln Gas Flow (scfh)	Kiln Air Flow (scfh)	Kiln Oxygen Flow (scfh)	Kiln Second Air DP (°wc)	AB Temp (F)	AB Gas Flow (scfh)	AB Air Flow (scfh)	AB Oxygen Flow (scfh)	Make-up Water cum. (gal)	Make-up Water rate (gpm)	Blowdown Water cum. (gal)	Blowdown Water rate (gpm)	Blowdown Water rate (gpm)	Water Evap. rate (gpm)	Venturi Scrubber Flow (gpm)
1145	1773.0	1856	520	11560	2460	4	2020	410	9030	1260	2851	—	2260	—	1.8	—	16
1200	1708.0	1788	170	7300	1810	4	2001	440	10620	1340	2922	4.7	2279	1.3	0.5	4.2	16
1215	1655.0	1869	170	6070	2870	4	2018	430	9530	2490	2963	2.7	2285	0.4	0.5	2.2	16
1230	1585.0	1811	170	6140	2910	4	2017	390	8580	2510	3014	3.4	2292	0.5	0.5	2.9	16
1245	1537.0	1816	220	7010	2960	4	2011	440	9530	2510	3062	3.2	2298	0.4	0.5	2.7	16
1300	1513.5	1795	200	6430	3230	4	2016	480	10220	2030	3125	4.2	2304	0.4	0.5	3.7	16
1315	1418.5	1818	170	6170	3090	4	2023	420	9330	2490	3189	4.3	2312	0.5	0.5	3.8	16
1330	1395.0	1720	180	6120	3090	4	2017	480	10420	2510	3257	4.5	2320	0.5	0.5	4.0	16
1345	1300.5	1825	170	6070	3020	4	2022	440	9530	2510	3318	4.1	2326	0.4	0.5	3.6	16
1400	1229.0	1811	170	6320	3000	4	2018	450	9800	1400	3401	5.5	2336	0.7	0.8	4.7	16
1415	1181.5	1840	170	6050	1166	4	2025	450	9750	2500	3478	5.1	2347	0.7	0.8	4.3	16
1430	1174.5	1815	160	6100	3050	4	2012	450	9730	2500	3525	3.1	2354	0.5	0.8	2.3	16
1445	1063.0	1891	170	6220	2900	4	2018	430	9370	2490	3584	3.9	2362	0.5	0.8	3.1	16
1500	1015.5	1819	160	6070	3100	4	2018	450	9790	2490	3633	3.3	2369	0.5	0.8	2.5	16
1515	967.5	1778	160	6070	2880	4	2008	450	9730	2490	3711	5.2	2380	0.7	0.8	4.4	16
1530	823.5	1780	160	6040	3010	4	2019	430	9530	2500	3767	3.7	2387	0.5	0.8	2.9	16
1545	823.5	1773	160	6060	2900	4	2018	420	10320	2510	3835	4.5	2397	0.7	0.8	3.7	16
1600	776.0	1845	170	12300	3010	4	2011	400	8990	2370	3899	4.3	2406	0.6	0.8	3.5	16
1615	728.5	1836	160	6170	2920	4	2007	400	8730	2510	3966	4.5	2417	0.7	0.5	4.0	16
1630	681.0	1873	170	6040	1270	4	2024	470	10420	1440	4037	4.7	2427	0.7	0.5	4.2	16
1645	680.5	1750	390	9680	2010	4	2011	460	9970	1390	4098	4.1	2435	0.5	0.5	3.6	16
1700	680.5	1815	260	6030	580	0	2010	570	13300	1220	4170	4.8	2444	0.6	0.5	4.3	16
1715	680.5	1821	290	6920	620	0	2030	490	11320	1020	4234	4.3	2454	0.7	0.5	3.8	16

Test : 21# Charge
Date : 1-21-88

Time	Scale Weight (lbs)	Kiln Temp (F)	Kiln Gas Flow (scfh)	Kiln Air Flow (scfh)	Kiln Oxygen Flow (scfh)	Kiln Second Air DP ("wc)	AB Temp (F)	AB Gas Flow (scfh)	AB Air Flow (scfh)	AB Oxygen Flow (scfh)	Make-up Water cum. (gal)	Make-up Water rate (gpm)	Blowdown Water cum. (gal)	Blowdown Water rate (gpm)	Blowdown Water rate (gpm)	Water Evap. rate (gpm)	Venturi Scrubber Flow (gpm)
1145	1773.0	1856	520	11560	2460	4	2020	410	9030	1260	2851	—	2260	—	1.8	—	16
1200	1708.0	1788	170	7300	1810	4	2001	440	10620	1340	2922	4.7	2279	1.3	0.5	4.2	16
1215	1655.0	1869	170	6070	2870	4	2018	430	9530	2490	2963	2.7	2285	0.4	0.5	2.2	16
1230	1585.0	1811	170	6140	2910	4	2017	390	8580	2510	3014	3.4	2292	0.5	0.5	2.9	16
1245	1537.0	1816	220	7010	2960	4	2011	440	9530	2510	3062	3.2	2298	0.4	0.5	2.7	16
1300	1513.5	1795	200	6430	3230	4	2016	480	10220	2030	3125	4.2	2304	0.4	0.5	3.7	16
1315	1418.5	1818	170	6170	3090	4	2023	420	9330	2490	3189	4.3	2312	0.5	0.5	3.8	16
1330	1395.0	1720	180	6120	3090	4	2017	480	10420	2510	3257	4.5	2320	0.5	0.5	4.0	16
1345	1300.5	1825	170	6070	3020	4	2022	440	9530	2510	3318	4.1	2326	0.4	0.5	3.6	16
1400	1229.0	1811	170	6320	3000	4	2018	450	9800	1400	3401	5.5	2336	0.7	0.8	4.7	16
1415	1181.5	1840	170	6050	1166	4	2025	450	9750	2500	3478	5.1	2347	0.7	0.8	4.3	16
1430	1174.5	1815	160	6100	3050	4	2012	450	9730	2500	3525	3.1	2354	0.5	0.8	2.3	16
1445	1063.0	1891	170	6220	2900	4	2018	430	9370	2490	3584	3.9	2362	0.5	0.8	3.1	16
1500	1015.5	1819	160	6070	3100	4	2018	450	9790	2490	3633	3.3	2369	0.5	0.8	2.5	16
1515	967.5	1778	160	6070	2880	4	2008	450	9730	2490	3711	5.2	2380	0.7	0.8	4.4	16
1530	823.5	1780	160	6040	3010	4	2019	430	9530	2500	3767	3.7	2387	0.5	0.8	2.9	16
1545	823.5	1773	160	6060	2900	4	2018	420	10320	2510	3835	4.5	2397	0.7	0.8	3.7	16
1600	776.0	1845	170	12300	3010	4	2011	400	8990	2370	3899	4.3	2406	0.6	0.8	3.5	16
1615	728.5	1836	160	6170	2920	4	2007	400	8730	2510	3966	4.5	2417	0.7	0.5	4.0	16
1630	681.0	1873	170	6040	1270	4	2024	470	10420	1440	4037	4.7	2427	0.7	0.5	4.2	16
1645	680.5	1750	390	9680	2010	4	2011	460	9970	1390	4098	4.1	2435	0.5	0.5	3.6	16
1700	680.5	1815	260	6030	580	0	2010	570	13300	1220	4170	4.8	2444	0.6	0.5	4.3	16
1715	680.5	1821	290	6920	620	0	2030	490	11320	1020	4234	4.3	2454	0.7	0.5	3.8	16

Test : 21# Charge
Date : 1-21-88

Time	Packed Column Flow (gpm)	Venturi DP ("wc)	Packed Column DP ("wc)	Liquor pH	ID Fan Inlet ("wc)	Kiln P ("wc)	AB Exit O2 (%)	AB Exit CO2 (%)	AB Exit CO (ppm)	AB Exit NOx (ppm)	AB Exit THC (ppm C	Kiln Exit O2 (%)	Kiln Exit CO2 (%)	Kiln Exit CO (ppm)	Kiln Exit THC (ppm C	Stack O2 (%)	Stack CO2 (%)	Stack CO (ppm)
1145	26	30	6	7.2	23	-0.05	15.5	5.7	0	1300	0	16.5	4.9	0.2	0	16.0	6.1	0.0
1200	27	30	6	7.4	28	-0.03	15.5	8.5	0	1150	0	14.5	7.3	9.0	0	16.0	8.2	0.0
1215	27	30	6	7.0	28	-0.03	15.5	9.2	0	950	0	15.5	8.6	8.0	0	15.0	8.4	0.0
1230	27	24	6	7.0	25	-0.04	16.5	6.9	0	850	0	17.5	8.2	20.0	0	17.5	7.3	0.0
1245	27	24	6	7.0	25	-0.03	15.5	8.2	0	850	0	16.5	10.2	19.0	0	16.0	8.6	0.0
1300	27	24	6	7.3	25	-0.02	15.5	8.4	0	900	0	16.0	10.9	14.1	0	16.0	8.6	0.0
1315	17	24	6	6.8	25	-0.05	16.0	7.6	0	800	0	15.5	9.9	18.3	0	16.0	8.2	0.0
1330	26	25	6	7.0	25	-0.02	15.0	8.7	0	600	0	14.0	10.4	10.4	0	16.0	8.0	0.0
1345	26	25	6	6.6	25	-0.04	15.0	6.6	0	750	0	15.4	10.2	14.3	0	16.0	8.5	0.0
1400	26	23	6	7.0	25	-0.02	15.0	8.4	0	500	0	16.0	10.3	14.1	0	15.5	8.7	0.0
1415	26	23	6	7.0	24	-0.02	17.0	8.6	0	650	0	17.0	10.6	10.9	0	15.5	8.6	0.0
1430	26	22	6	7.0	25	-0.03	15.0	7.5	0	600	0	13.5	10.0	11.4	0	15.0	8.4	0.0
1445	26	25	6	7.1	25	-0.03	15.5	7.7	0	600	0	14.5	8.5	15.6	0	15.5	8.6	0.0
1500	26	25	6	7.2	25	-0.04	15.5	8.2	0	600	0	15.5	10.0	11.5	0	16.0	8.7	0.0
1515	26	25	6	7.1	24	-0.04	15.5	8.0	0	650	0	16.0	11.6	14.0	0	16.0	8.1	0.0
1530	26	25	6	7.1	24	-0.03	15.5	7.5	0	658	0	15.0	10.1	14.8	0	16.0	8.1	0.0
1545	26	25	6	8.2	24	-0.03	15.0	8.3	0	700	0	15.0	12.2	14.8	0	16.0	8.8	0.0
1600	26	25	6	8.2	24	-0.05	14.8	8.2	0	600	0	15.2	10.7	14.0	0	16.0	7.6	0.0
1615	26	21	6	6.4	24	-0.04	16.0	7.7	0	600	0	15.0	10.2	14.6	0	16.0	8.4	0.0
1630	26	20	6	8.4	24	-0.04	14.5	6.1	0	200	0	14.5	7.3	38.0	0	14.5	7.0	0.0
1645	26	20	6	7.0	20	-0.04	14.5	6.3	0	0	0	15.0	6.7	14.0	0	15.0	7.2	0.0
1700	26	20	6	7.2	23	-0.15	14.0	5.7	0	0	0	15.0	4.9	1.1	0	14.0	6.5	0.0
1715	26	20	6	7.0	23	-0.13	14.0	5.3	0	0	0	15.0	5.1	0.6	0	14.0	6.2	0.0

Test : 80 Charge
Date : 1-27-88

Time	Scale Weight (lbs)	Kiln Temp (F)	Kiln Gas Flow (scfh)	Kiln Air Flow (scfh)	Kiln Oxygen Flow (scfh)	Kiln Second Air DP ("wc)	AB Temp (F)	AB Gas Flow (scfh)	AB Air Flow (scfh)	AB Oxygen Flow (scfh)	Make-up Water cum. (gal)	Make-up Water rate (gpm)	Blowdown Water cum. (gal)	Blowdown Water rate (gpm)	Blowdown Water rate (gpm)	Water Evap. rate (gpm)	Venturi Scrubber Flow (gpm)
1030	973.5	1890	390	10900	560	0	2029	390	9330	1050	1614	—	6377	—	1.8	—	23
1045	932.5	1853	420	12720	480	0	2011	380	9040	1030	1632	1.2	6388	0.7	0.5	0.7	17
1100	932.5	1867	380	11580	440	0	2025	390	9530	1080	1632	0.0	6395	0.5	0.5	-0.5	17
1115	923.0	1867	360	11740	490	0	2016	370	8830	990	1654	1.5	6400	0.3	0.5	1.0	17
1130	896.0	1872	350	10580	340	0	2017	360	8670	970	1686	2.1	6406	0.4	0.5	1.6	17
1145	842.5	1874	340	10290	400	0	2019	380	9130	1050	1730	2.9	6414	0.5	0.5	2.4	17
1200	806.5	1864	340	10150	380	0	2020	370	8960	1000	1774	2.9	6419	0.3	0.2	2.7	17
1215	771.0	1871	340	10140	350	0	2017	370	9030	1020	1823	3.3	6430	0.7	0.7	2.6	17
1230	734.5	1857	330	9840	380	0	2017	360	8820	980	1869	3.1	6440	0.7	0.7	2.4	17
1245	698.5	1853	330	9890	380	0	2016	370	8860	980	1911	2.8	6449	0.6	0.7	2.1	17
1300	653.5	1869	380	9980	340	0	2012	370	8940	980	1966	3.7	6461	0.8	0.5	3.2	17
1315	653.5	1848	330	10010	360	0	2017	380	9130	1020	1996	2.0	6467	0.4	0.5	1.5	17
1330	599.0	1865	330	10240	320	0	2017	370	8950	1020	2036	2.7	6476	0.6	0.5	2.2	17
1345	572.0	1864	330	9890	290	0	2018	390	9280	1050	2081	3.0	6484	0.5	0.5	2.5	17
1400	545.0	1881	250	7490	290	0	2018	390	9450	1080	2131	3.3	6493	0.6	0.5	2.8	17
1415	491.5	1874	310	9480	370	0	2015	390	9330	1050	2167	2.4	6499	0.4	0.5	1.9	17
1430	473.0	1866	280	8840	300	0	2012	390	9430	1060	2208	2.7	6506	0.5	0.5	2.2	17
1445	446.0	1865	280	8680	330	0	2018	400	9650	1090	2250	2.8	6514	0.5	0.5	2.3	17
1500	405.5	1857	320	9610	310	0	2013	400	9420	1060	2292	2.8	6522	0.5	0.5	2.3	17
1515	401.0	1877	280	8530	300	0	2019	390	9430	1080	2329	2.5	6529	0.5	0.5	2.0	17
1530	365.0	1862	280	8460	350	0	2015	390	9310	1040	2372	2.9	6537	0.5	0.5	2.4	17
1545	329.0	1867	300	9020	340	0	2016	390	9390	1060	2401	1.9	6543	0.4	0.5	1.4	17
1600	311.5	1872	300	8970	330	0	2014	390	9240	1040	2444	2.9	6551	0.5	0.5	2.4	17
1615	320.5	1866	280	8500	290	0	2013	390	9250	1050	2482	2.5	6559	0.5	0.5	2.0	17
1630	320.5	1859	290	8880	290	0	2014	370	9030	1020	2530	3.2	6568	0.6	0.5	2.7	17
1645	320.5	1855	300	9010	310	0	2013	390	9430	1050	2561	2.1	6575	0.5	0.5	1.6	17
1700	320.5	1853	290	8930	290	0	2013	400	9430	1080	2597	2.4	6582	0.5	0.5	1.9	17

Test : 8# Charge
Date : 1-27-88

Time	Packed Column Flow (gpm)	Venturi DP ("wc)	Packed Column DP ("wc)	Liquor pH	ID Fan Inlet ("wc)	Kiln P ("wc)	AB Exit O2 (%)	AB Exit CO2 (%)	AB Exit CO (ppm)	AB Exit NOx (ppm)	AB Exit THC (ppm C	Kiln Exit O2 (%)	Kiln Exit CO2 (%)	Kiln Exit CO (ppm)	Kiln Exit THC (ppm C	Stack O2 (%)	Stack CO2 (%)	Stack CO (ppm)
1030	27	22	7	6.8	16	-0.05	15.0	5.0	1.5	0	0	14.0	6.6	0.0	0	15.5	5.6	0
1045	28	25	7	6.6	27	-0.03	13.0	5.2	1.5	0	0	14.0	4.9	0.0	0	15.0	5.7	0
1100	27	25	7	6.6	26	-0.02	13.0	5.4	1.5	0	0	13.5	5.2	0.0	0	14.0	6.4	0
1115	27	25	7	6.6	25	-0.02	12.5	6.8	1.6	0	0	12.5	6.4	0.0	0	14.5	6.5	0
1130	27	25	7	6.2	25	-0.03	13.0	5.6	1.5	0	0	13.0	6.4	0.0	0	15.0	6.1	0
1145	27	25	7	6.6	25	-0.03	13.0	6.3	1.5	0	0	13.0	5.8	0.0	0	14.5	6.6	0
1200	27	25	7	7.6	25	-0.02	13.0	6.5	1.5	0	0	13.0	6.7	0.0	0	14.5	6.2	0
1215	27	30	7	7.9	25	-0.03	13.0	6.3	1.6	0	0	13.2	5.5	0.0	0	14.0	6.4	0
1230	27	30	7	6.6	25	-0.03	13.0	6.4	1.5	0	0	12.5	6.1	0.0	0	14.5	6.2	0
1245	27	30	7	8.4	25	-0.02	13.5	6.4	1.6	0	0	13.0	5.6	1.6	0	14.5	6.2	0
1300	26	30	7	6.8	25	-0.03	13.5	5.8	1.6	0	0	14.0	5.8	-1.6	0	14.5	6.2	0
1315	26	30	7	8.0	24	-0.03	13.0	6.2	1.6	0	0	12.5	6.8	-1.8	0	14.5	6.2	0
1330	26	30	7	6.6	24	-0.03	13.0	6.6	1.7	0	0	11.0	6.4	-1.9	0	14.0	6.4	0
1345	26	30	7	7.1	24	-0.01	14.0	5.6	1.7	0	0	13.0	6.7	-3.3	0	14.5	6.3	0
1400	26	30	7	7.9	24	-0.01	14.0	6.1	1.9	0	0	11.5	6.0	-3.1	0	14.7	6.0	0
1415	26	30	7	6.6	23	0.00	13.5	6.7	1.9	0	0	12.0	6.6	-2.3	0	15.0	6.1	0
1430	26	30	7	7.6	23	-0.01	13.0	6.2	2.0	0	0	13.5	4.8	-2.5	0	15.0	6.0	0
1445	26	30	7	6.4	23	-0.01	13.0	6.2	1.9	0	0	13.5	4.9	-2.5	0	15.0	5.9	0
1500	26	30	7	8.4	23	-0.01	13.0	5.3	2.1	0	0	14.5	3.4	2.4	0	15.0	5.4	0
1515	26	30	7	7.2	23	-0.01	13.5	6.0	2.7	0	0	14.5	4.8	2.0	0	15.0	5.8	0
1530	26	30	7	7.0	23	-0.01	13.5	5.8	1.9	0	0	15.0	2.6	3.8	0	15.0	5.5	0
1545	26	30	7	7.1	23	-0.01	11.0	5.8	2.0	0	0	13.5	5.2	3.3	0	15.0	5.3	0
1600	26	30	7	7.8	23	-0.01	11.5	6.2	2.0	0	0	13.0	7.1	3.5	0	15.0	5.7	0
1615	26	30	7	7.2	23	0.00	14.0	5.5	2.0	0	0	13.0	6.2	2.7	0	15.0	5.7	0
1630	26	30	7	7.2	23	0.00	14.5	5.3	2.0	0	0	16.0	3.0	1.8	0	15.5	5.4	0
1645	26	30	7	7.1	23	0.00	14.0	5.5	2.0	0	0	14.0	5.4	2.4	0	15.5	5.4	0
1700	26	30	7	8.4	23	0.00	14.0	5.4	2.0	0	0	14.5	4.2	2.0	0	15.5	5.4	0

Test : 80 Charge
Date : 1-29-88

Time	Scale Weight (lbs)	Kiln Temp (F)	Kiln Gas Flow (scfh)	Kiln Air Flow (scfh)	Kiln Oxygen Flow (scfh)	Kiln Second Air DP ("wc)	AB Temp (F)	AB Gas Flow (scfh)	AB Air Flow (scfh)	AB Oxygen Flow (scfh)	Make-up Water cum. (gal)	Make-up Water rate (gpm)	Blowdown Water cum. (gal)	Blowdown Water rate (gpm)	Blowdown Water rate (gpm)	Water Evap. rate (gpm)	Venturi Scrubber Flow (gpm)
845	748.5	1777	290	9070	0	0	2016	630	19060	0	5671	—	7080	—	0.0	—	17
900	712.0	1752	280	8010	0	0	2020	580	16580	0	5735	4.3	7080	0.0	0.0	4.3	17
915	712.0	1683	300	8590	0	0	1970	510	14990	0	5849	7.6	7105	1.7	1.5	6.1	17
930	712.0	1667	300	8680	0	0	1945	510	14490	0	5895	3.1	7119	0.9	1.5	1.6	17
945	712.0	1651	300	7300	0	0	1936	520	13460	0	5948	3.5	7138	1.3	1.5	2.0	17
1000	712.0	1688	310	7370	0	0	1958	520	12900	0	6039	6.1	7163	1.7	1.5	4.6	17
1015	712.0	1648	300	7340	0	0	1862	300	7350	0	6087	3.2	7180	1.1	1.5	1.7	17
1030	712.0	1653	300	7050	0	0	1839	400	9740	0	6126	2.6	7196	1.1	1.2	1.4	17
1045	712.0	1717	300	4900	0	0	1834	390	9730	0	6205	5.3	7214	1.2	1.0	4.3	17
1100	712.0	1858	400	7220	0	0	1940	610	11440	0	6249	2.9	7231	1.1	1.0	1.9	17
1115	712.0	1855	330	5340	0	0	2022	500	8390	0	6310	4.1	7245	0.9	0.5	3.6	17
1130	712.0	1885	350	6330	0	0	2024	490	8160	0	6349	2.6	7250	0.3	0.0	2.6	17
1145	667.0	1856	330	5180	0	0	2016	480	8100	0	6406	3.8	7260	0.7	0.7	3.1	17
1200	667.0	1932	400	6550	0	0	2024	470	7910	0	6467	4.1	7271	0.7	0.8	3.3	17
1215	649.5	1829	360	6340	0	0	2017	490	8110	0	6527	4.0	7282	0.7	0.7	3.3	17
1230	611.0	1886	380	6670	0	0	2016	460	7900	0	6572	3.0	7290	0.5	0.7	2.3	17
1245	592.5	1859	320	5440	0	0	2014	460	7860	0	6632	4.0	7298	0.5	0.5	3.5	17
1300	536.0	1849	340	6150	0	0	2015	476	7930	0	6685	3.5	7306	0.5	0.5	3.0	17
1315	519.0	1886	350	5290	0	0	2018	460	7870	0	6747	4.1	7313	0.5	0.5	3.6	17
1330	483.0	1873	380	6670	0	0	2019	450	7640	0	6809	4.1	7319	0.4	0.5	3.6	17
1345	447.0	1875	380	7100	0	0	2016	480	8040	0	6841	2.1	7322	0.2	0.7	1.4	17
1400	411.0	1854	330	5360	0	0	2011	460	7920	0	6894	3.5	7326	0.3	0.2	3.3	17
1415	393.0	1883	340	5860	0	0	2015	460	7840	0	6974	5.3	7330	0.3	0.2	5.1	17
1430	389.5	1845	310	4970	0	0	2014	480	8000	0	7000	1.7	7334	0.3	0.5	1.2	17
1445	312.0	1874	320	5060	0	0	2015	460	7890	0	7049	3.3	7341	0.5	0.5	2.8	17
1500	204.0	1882	270	3880	0	0	2015	460	7740	0	7118	4.6	7351	0.7	0.5	4.1	17
1515	260.0	1873	290	4480	0	0	2013	440	7540	0	7169	3.4	7359	0.5	0.5	2.9	17
1530	260.0	1874	410	7530	0	0	2010	470	8040	0	7212	2.9	7364	0.3	0.5	2.4	17
1545	260.0	1877	330	5360	0	0	2012	460	7870	0	7273	4.1	7372	0.5	0.5	3.6	17
1600	260.0	1858	350	6110	0	0	2013	480	8040	0	7312	2.6	7377	0.3	0.5	2.1	17

Test : 80 Charge
Date : 1-29-88

Time	Packed Column Flow (gpm)	Venturi DP ("wc)	Packed Column DP ("wc)	Liquor pH	ID Fan Inlet ("wc)	Kiln P ("wc)	AB Exit O2 (%)	AB Exit CO2 (%)	AB Exit CO (ppm)	AB Exit NOx (ppm)	AB Exit THC (ppm C	Kiln Exit O2 (%)	Kiln Exit CO2 (%)	Kiln Exit CO (ppm)	Kiln Exit THC (ppm C	Stack O2 (%)	Stack CO2 (%)	Stack CO (ppm)
845	27	20	9	7.2	26	-0.01	12.5	4.5	1.6	0	0	15.5	2.2	0.3	0	14.0	4.8	0.0
900	26	20	8	7.5	26	-0.01	12.5	4.4	3.3	200	0	15.5	2.3	0.4	0	14.0	4.4	0.0
915	26	20	11	7.4	26	-0.01	12.5	4.2	34.5	550	0	15.5	2.0	0.7	0	15.0	4.2	0.0
930	26	20	8	7.1	26	-0.02	13.0	4.0	6.0	150	0	16.5	2.0	0.1	0	15.0	4.0	0.0
945	26	20	8	7.1	24	-0.02	12.5	4.5	8.3	50	0	16.5	2.0	0.2	0	15.0	4.3	0.0
1000	26	25	6	7.6	27	0.00	12.0	4.4	0.8	50	0	15.5	2.0	0.3	0	15.0	4.3	0.0
1015	26	25	2	7.1	28	-0.02	14.5	3.1	0.8	50	0	16.5	1.7	0.0	0	16.0	3.1	0.0
1030	26	25	4	7.3	27	-0.02	13.0	4.0	0.8	25	0	15.5	2.5	0.0	0	15.0	3.7	0.0
1045	26	25	3	8.0	27	0.00	12.5	4.7	1.1	25	0	9.5	6.9	0.2	0	15.0	4.2	0.0
1100	26	25	4	7.0	27	-0.01	10.0	6.3	1.3	25	0	8.0	7.3	0.8	0	12.5	5.5	0.0
1115	26	25	4	7.2	26	-0.02	12.0	5.1	1.2	50	0	11.0	5.4	0.6	0	14.0	4.5	0.0
1130	26	25	4	7.1	25	-0.02	11.5	5.3	1.2	50	0	9.5	6.2	0.6	0	13.5	4.9	0.0
1145	26	25	4	7.1	25	-0.02	12.0	5.0	1.2	100	0	11.0	5.4	0.7	0	14.0	4.4	0.0
1200	26	25	4	7.8	25	-0.02	11.5	5.2	1.3	50	0	9.5	6.6	0.8	0	13.8	5.0	0.0
1215	26	25	4	7.6	25	-0.03	11.0	5.6	1.3	30	0	8.0	7.3	1.4	0	13.0	5.0	0.0
1230	26	25	4	7.6	25	-0.04	11.2	5.3	1.2	25	0	8.5	6.7	1.3	0	14.0	4.8	0.0
1245	26	25	4	7.8	24	-0.03	11.5	5.2	1.3	37	0	9.2	5.8	1.3	0	14.0	4.6	0.0
1300	26	25	4	7.6	23	-0.01	11.0	5.9	1.6	40	0	8.5	7.7	1.4	0	14.0	4.9	0.0
1315	26	25	4	8.4	23	-0.02	11.0	5.1	1.6	30	0	8.5	6.0	1.1	0	15.0	4.9	0.0
1330	26	25	4	6.0	23	-0.02	11.0	6.0	1.8	40	0	8.5	9.3	3.0	0	14.0	4.3	0.0
1345	26	25	4	7.4	23	-0.02	10.5	5.6	1.8	22	0	8.0	7.3	1.3	0	14.0	5.0	0.0
1400	26	25	4	6.4	23	-0.01	11.5	5.6	1.6	22	0	9.5	7.2	1.3	0	14.0	4.6	0.0
1415	26	25	4	7.8	22	-0.01	11.0	5.3	1.6	15	0	8.0	6.1	1.2	0	13.5	4.9	0.0
1430	26	25	4	7.9	22	-0.02	11.0	5.2	1.5	22	0	8.0	7.0	1.3	0	14.0	4.5	0.0
1445	26	25	4	6.8	22	-0.01	11.5	5.2	1.4	20	0	10.0	6.0	1.2	0	13.5	4.8	0.0
1500	26	25	4	6.2	22	-0.01	10.5	6.2	1.6	20	0	7.0	9.5	19.1	0	13.5	5.1	0.0
1515	26	25	4	8.0	22	-0.01	10.5	6.1	1.3	0	0	7.0	9.8	16.9	0	13.5	5.3	0.0
1530	26	25	4	6.8	22	-0.01	10.5	6.1	1.2	0	0	7.5	8.6	3.0	0	13.0	5.1	0.0
1545	26	25	4	6.8	22	-0.01	11.5	5.2	2.8	0	0	9.5	6.1	1.4	0	13.0	4.6	0.0
1600	26	25	4	7.2	22	-0.01	11.0	5.5	6.2	0	0	9.0	6.1	1.0	0	13.5	4.6	0.0

APPENDIX B
SAMPLING TRAIN PERFORMANCE WORKSHEETS

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**********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                         Performed by:     C.KING
Date:  12-09-87                    Test No./Type:    E12091310MMST1
Sample Location: E-DUCT            Start/Stop Time:  1310-1719

PARAMETER                           SYMBOL     VALUE
                                               (calc.)
Nozzle Diameter, Actual (in)        N(d)        0.375
Pitot Tube Correction Factor        C(p)        0.8400
Gas Meter Correction Factor         (alpha)     0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)           R             7.00
        Length (if rectangular)     L          --------
        Width (if rectangular)      W          --------
Area of Stack (sq ft)               A(s)      (   1.07 )

# of Sample Points                  #               10
Total Sampling Time (min)           (theta)   ( 200.00 )
Barometric Pressure (in Hg)         P(b)        29.92
Stack Pressure (in H2O)             P(stack)    -0.080
Gas Meter Initial Reading (cu ft)               634.55
Gas Meter Final Reading (cu ft)                 804.21
Net Gas Sample Volume (cu ft)       V(m)      ( 169.66 )

Vol of Liquid Collected (ml)        Vl(c)       2550.7
Vol of Liq @ Std. Conds. (scf)      V(w std)  (120.061 )
Wt. of Filter Particulate (gm)                  0.0000
Wt. of Probe Wash Particulate (gm)              0.0000
Wt of Combined Particulate (gm)     M(p)      ( 0.0000 )

O2  Concentration (by CEM)          % O2        13.78
CO2 Concentration (by CEM)          % CO2        6.72
CO  Concentration (by CEM)          % CO         0.0
N2  Concentration (by diff.)        % N2      (  79.50 )
---------------------------------------------------------------------------
Sample : dClock :Velocity:Orifice :  Stack  :    Gas  Meter    :SQRT(dP) :
Point  :  Time  :Head, dP:Meter,dH:  Temp   :   Temp  (degF)   :         :
       :        :(in H2O):(in H2O): (degF)  :    in   :  out   :         :
-------+--------+--------+--------+---------+---------+--------+---------:
     4 :     25 :   0.35 : 2.9000 :  170.0  :   83.0  :   62.0 :  0.5916 :
     3 :     25 :   0.35 : 2.9000 :  170.0  :  116.0  :   79.0 :  0.5916 :
     2 :     25 :   0.35 : 2.9000 :  170.0  :  129.0  :   99.0 :  0.5916 :
     1 :     25 :   0.35 : 2.9000 :  170.0  :  130.0  :   99.0 :  0.5916 :
     1 :     14 :   0.35 : 2.9000 :  170.0  :   90.0  :   75.0 :  0.5916 :
     1 :     11 :   0.35 : 2.9000 :  170.0  :   90.0  :   76.0 :  0.5916 :
     2 :     25 :   0.31 : 2.6000 :  170.0  :  112.0  :   78.0 :  0.5568 :
     3 :      9 :   0.31 : 2.6000 :  170.0  :  114.0  :   79.0 :  0.5568 :
     3 :     16 :   0.29 : 2.4000 :  170.0  :  110.0  :   77.0 :  0.5385 :
     4 :     25 :   0.26 : 2.2000 :  170.0  :  110.0  :   77.0 :  0.5099 :
     0 :      0 :   0.00 : 0.0000 :    0.0  :    0.0  :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :    0.0  :    0.0  :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :    0.0  :    0.0  :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :    0.0  :    0.0  :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :    0.0  :    0.0  :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :    0.0  :    0.0  :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :    0.0  :    0.0  :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :    0.0  :    0.0  :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :    0.0  :    0.0  :    0.0 :  0.0000 :
-------+--------+--------+--------+---------+---------+--------+---------:
TOTALS :    200 :   3.27 :27.2000 : 1700.0  : 1084.0  :  801.0 :  5.7116 :
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)           dP(avg)  =   0.327

 Avg Orifice Meter Reading (in H2O)   dH(avg)  =   2.720

 Avg Stack Temperature (degF)         T(s avg) =   170.0

 Average Meter Temperature (degF)     T(m avg) =    94.2

 Avg SQRT(dP)                                  =   0.571

CALCULATED VALUES

 Meter Volume (std, cu. ft.)          V(m std) =  161.02

 Stack Gas Water Vapor Proportion     B(wo)    =   0.427

 Mol. Wt., Stack Gas Dry              M(d)     =   29.63

 Mol. Wt., Stack Gas Wet              M(s)     =   24.66

 Abs Stack Pressure (in Hg)           P(s)     =   29.91

 Avg Stack Velocity (ft/sec)          V(s avg) =    37.9

 Isokineticity (%)                    % I      =    96.2

 Stack Gas STD Vol Flow (dscfm)       Q(s)     =    1167

 Actual Stack Gas Vol Flow (acfm)     Q(a)     =    2431

 Particulate Loading, dry(gr/dscf)    C(s std) =  0.0000
 Particulate Loading, @7% O2(mg/dscm)C(s std)  =       0
 Particulate Loading, dry @ 7 % O2 (gr/dscf)   =  0.0000

:Particulate Emission Rate(lb/hr)     E(p)     =   0.000
```

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********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                         Performed by:     C.KING
Date:  12-9-87                     Test No./Type:    E12091310MM5 T2
Sample Location: E-DUCT            Start/Stop Time:  1310-1719

PARAMETER                           SYMBOL    VALUE
                                             (calc.)
Nozzle Diameter, Actual (in)       N(d)        0.375
Pitot Tube Correction Factor       C(p)        0.8400
Gas Meter Correction Factor        (alpha)     0.9900
Stack (Duct) Dimensions (in):
       Radius (if round)           R            7.00
       Length (if rectangular)     L          --------
       Width (if rectangular)      W          --------
Area of Stack (sq ft)              A(s)     (   1.07 )

# of Sample Points                 #              10
Total Sampling Time (min)          (theta)  ( 200.00 )
Barometric Pressure (in Hg)        P(b)        29.92
Stack Pressure (in H2O)            P(stack)   -0.080
Gas Meter Initial Reading (cu ft)             182.51
Gas Meter Final Reading (cu ft)               360.29
Net Gas Sample Volume (cu ft)      V(m)     ( 177.78 )

Vol of Liquid Collected (ml)       Vl(c)      2368.1
Vol of Liq @ Std. Conds. (scf)     V(w std) (111.465 )
Wt. of Filter Particulate (gm)                0.0000
Wt. of Probe Wash Particulate (gm)            0.0000
Wt of Combined Particulate (gm)    M(p)     ( 0.0000 )

O2  Concentration (by CEM)         % O2        13.78
CO2 Concentration (by CEM)         % CO2        6.72
CO  Concentration (by CEM)         % CO         0.0
N2  Concentration (by diff.)       % N2     (  79.50 )
-------------------------------------------------------------------------
Sample : dClock :Velocity:Orifice :  Stack   :    Gas  Meter   :SQRT(dP) :
Point  :  Time  :Head, dP:Meter,dH:  Temp    :   Temp  (degF)  :         :
       :        :(in H2O):(in H2O): (degF)   :   in    :  out  :         :
-------+--------+--------+--------+----------+---------+-------+---------:
     1 :     25 :   0.35 : 2.9000 :   170.0 :    92.0 :   82.0 :  0.5916 :
     2 :     25 :   0.35 : 2.9000 :   170.0 :   103.0 :   82.0 :  0.5916 :
     3 :     25 :   0.35 : 2.9000 :   170.0 :   129.0 :   93.0 :  0.5916 :
     4 :     25 :   0.35 : 2.9000 :   170.0 :   130.0 :   94.0 :  0.5916 :
     1 :     14 :   0.25 : 2.2000 :   170.0 :   112.0 :   80.0 :  0.5000 :
     1 :     11 :   0.33 : 2.8000 :   170.0 :   112.0 :   80.0 :  0.5745 :
     2 :     25 :   0.30 : 2.5000 :   170.0 :   120.0 :   85.0 :  0.5477 :
     3 :      9 :   0.30 : 2.5000 :   170.0 :   120.0 :   86.0 :  0.5477 :
     3 :     16 :   0.29 : 2.4000 :   170.0 :   108.0 :   83.0 :  0.5385 :
     4 :     25 :   0.27 : 2.3000 :   170.0 :   106.0 :   83.0 :  0.5196 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :    0.0 :  0.0000 :
-------+--------+--------+--------+----------+---------+-------+---------:
TOTALS :    200 :   3.14 :26.3000 :  1700.0 :  1132.0 :  848.0 :  5.5945 :
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)              dP(avg)  =   0.314

 Avg Orifice Meter Reading (in H2O)      dH(avg)  =   2.630

 Avg Stack Temperature (degF)            T(s avg) =   170.0

 Average Meter Temperature (degF)        T(m avg) =    99.0

 Avg SQRT(dP)                                     =   0.559

CALCULATED VALUES

 Meter Volume (std, cu. ft.)             V(m std) =  167.25

 Stack Gas Water Vapor Proportion        B(wo)    =   0.400

 Mol. Wt., Stack Gas Dry                 M(d)     =   29.63

 Mol. Wt., Stack Gas Wet                 M(s)     =   24.98

 Abs Stack Pressure (in Hg)              P(s)     =   29.91

 Avg Stack Velocity (ft/sec)             V(s avg) =    36.9

 Isokineticity (%)                       % I      =    98.0

 Stack Gas STD Vol Flow (dscfm)          Q(s)     =    1190

 Actual Stack Gas Vol Flow (acfm)        Q(a)     =    2366

 Particulate Loading, dry(gr/dscf)       C(s std) =  0.0000
 Particulate Loading, @7% O2(mg/dscm)C(s std) =           0
 Particulate Loading, dry @ 7 % O2 (gr/dscf)      =  0.0000

:Particulate Emission Rate(lb/hr)        E(p)     =   0.000
```

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********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                        Performed by:     G.HILL
Date:  12-09-87                   Test No./Type:    E12091310MS
Sample Location: STACK            Start/Stop Time:  1310-1415

PARAMETER
                                   SYMBOL      VALUE
                                              (calc.)
Nozzle Diameter, Actual (in)       N(d)         0.357
Pitot Tube Correction Factor       C(p)        0.8400
Gas Meter Correction Factor        (alpha)     0.9700
Stack (Duct) Dimensions (in):
        Radius (if round)          R             7.00
        Length (if rectangular)    L         --------
        Width (if rectangular)     W         --------
Area of Stack (sq ft)              A(s)     (   1.07 )

# of Sample Points                 #               12
Total Sampling Time (min)          (theta)  (  60.00 )
Barometric Pressure (in Hg)        P(b)         29.92
Stack Pressure (in H2O)            P(stack)    -0.080
Gas Meter Initial Reading (cu ft)              975.63
Gas Meter Final Reading (cu ft)               1026.91
Net Gas Sample Volume (cu ft)      V(m)     (  51.28 )

Vol of Liquid Collected (ml)       Vl(c)        463.1
Vol of Liq @ Std. Conds. (scf)     V(w std) ( 21.796 )
Wt. of Filter Particulate (gm)                 0.0050
Wt. of Probe Wash Particulate (gm)             0.0000
Wt of Combined Particulate (gm)    M(p)     ( 0.0050 )

O2  Concentration (by CEM)         % O2         14.24
CO2 Concentration (by CEM)         % CO2         6.26
CO  Concentration (by CEM)         % CO           0.0
N2  Concentration (by diff.)       % N2     (  79.50 )
----------------------------------------------------------------------------
Sample ! dClock !Velocity!Orifice !  Stack   !    Gas    Meter   !SQRT(dP) !
Point  !  Time  !Head, dP!Meter,dH!  Temp    !   Temp   (degF)   !         !
       !        !(in H2O)!(in H2O)!  (degF)  !    in   !  out    !         !
-------+--------+--------+--------+----------+---------+---------+---------!
    E1 !      5 !   0.16 ! 1.3800 !   169.0  !   65.0  !   66.0  !  0.4000 !
     2 !      5 !   0.28 ! 2.4100 !   169.0  !   81.0  !   67.0  !  0.5292 !
     3 !      5 !   0.28 ! 2.4100 !   169.0  !   88.0  !   69.0  !  0.5292 !
     4 !      5 !   0.24 ! 2.0600 !   169.0  !   97.0  !   73.0  !  0.4899 !
     5 !      5 !   0.35 ! 3.0100 !   169.0  !  118.0  !   78.0  !  0.5916 !
     6 !      5 !   0.24 ! 2.0600 !   169.0  !  118.0  !   89.0  !  0.4899 !
    S1 !      5 !   0.24 ! 2.0600 !   169.0  !  112.0  !   90.0  !  0.4899 !
     2 !      5 !   0.35 ! 3.0100 !   169.0  !  113.0  !   92.0  !  0.5916 !
     3 !      5 !   0.35 ! 3.0100 !   169.0  !  128.0  !   92.0  !  0.5916 !
     4 !      5 !   0.24 ! 2.0600 !   169.0  !  129.0  !   94.0  !  0.4899 !
     5 !      5 !   0.30 ! 2.5800 !   169.0  !  123.0  !   96.0  !  0.5477 !
     6 !      5 !   0.30 ! 2.5800 !   169.0  !  119.0  !   94.0  !  0.5477 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0  !    0.0  !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0  !    0.0  !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0  !    0.0  !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0  !    0.0  !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0  !    0.0  !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0  !    0.0  !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0  !    0.0  !  0.0000 !
-------+--------+--------+--------+----------+---------+---------+---------!
TOTALS !     60 !   3.33 !28.6300 !  2028.0  ! 1291.0  ! 1000.0  !  6.2882 !
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)              dP(avg)   =   0.278

 Avg Orifice Meter Reading (in H2O)      dH(avg)   =   2.386

 Avg Stack Temperature (degF)            T(s avg)  =   169.0

 Average Meter Temperature (degF)        T(m avg)  =    95.5

 Avg SQRT(dP)
                                                   =   0.524
CALCULATED VALUES

 Meter Volume (std, cu. ft.)             V(m std)  =   47.54

 Stack Gas Water Vapor Proportion        B(wo)     =   0.314

 Mol. Wt., Stack Gas Dry                 M(d)      =   29.57

 Mol. Wt., Stack Gas Wet                 M(s)      =   25.93

 Abs Stack Pressure (in Hg)              P(s)      =   29.91

 Avg Stack Velocity (ft/sec)             V(s avg)  =    33.9

 Isokineticity (%)                       % I       =    97.5

 Stack Gas STD Vol Flow (dscfm)          Q(s)      =    1251

 Actual Stack Gas Vol Flow (acfm)        Q(a)      =    2173

Particulate Loading, dry(gr/dscf)   C(s std) =  0.0016
Particulate Loading, @7% O2(mg/dscm)C(s std) =       8
Particulate Loading, dry @ 7 % O2 (gr/dscf)  =  0.0034

Particulate Emission Rate(lb/hr)    E(p)     =   0.017
```

```
*********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                          Performed by:      C.KING
Date:  12-11-87                     Test No./Type:     E12111159MM5 T1
Sample Location: E-DUCT             Start/Stop Time:   1159-1537

PARAMETER                            SYMBOL     VALUE
                                                (calc.)
Nozzle Diameter, Actual (in)        N(d)        0.375
Pitot Tube Correction Factor        C(p)        0.8400
Gas Meter Correction Factor         (alpha)     0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)           R            7.00
        Length (if rectangular)     L          --------
        Width (if rectangular)      W          --------
Area of Stack (sq ft)               A(s)       (   1.07 )

# of Sample Points                  #               8
Total Sampling Time (min)           (theta)    ( 200.00 )
Barometric Pressure (in Hg)         P(b)         29.95
Stack Pressure (in H2O)             P(stack)    -0.080
Gas Meter Initial Reading (cu ft)               886.75
Gas Meter Final Reading (cu ft)                1047.36
Net Gas Sample Volume (cu ft)       V(m)       ( 160.61 )

Vol of Liquid Collected (ml)        Vl(c)       2094.7
Vol of Liq @ Std. Conds. (scf)      V(w std)   ( 98.596 )
Wt. of Filter Particulate (gm)                  0.0000
Wt. of Probe Wash Particulate (gm)              0.0000
Wt of Combined Particulate (gm)     M(p)       ( 0.0000 )

O2  Concentration (by CEM)          % O2         11.40
CO2 Concentration (by CEM)          % CO2         9.10
CO  Concentration (by CEM)          % CO          0.0
N2  Concentration (by diff.)        % N2       (  79.50 )
--------------------------------------------------------------------------
Sample ¦ dClock ¦Velocity¦Orifice ¦  Stack  ¦    Gas  Meter   ¦SQRT(dP) ¦
Point  ¦  Time  ¦Head, dP¦Meter,dH¦  Temp   ¦   Temp  (degF)  ¦         ¦
       ¦        ¦(in H2O)¦(in H2O)¦ (degF)  ¦    in   ¦  out  ¦         ¦
-------+--------+--------+--------+---------+---------+-------+---------¦
    T4 ¦     25 ¦   0.25 ¦ 2.1000 ¦   170.0 ¦    77.0 ¦  66.0 ¦  0.5000 ¦
     3 ¦     25 ¦   0.25 ¦ 2.1000 ¦   170.0 ¦   105.0 ¦  77.0 ¦  0.5000 ¦
     2 ¦     25 ¦   0.25 ¦ 2.1000 ¦   170.0 ¦   113.0 ¦  89.0 ¦  0.5000 ¦
     1 ¦     25 ¦   0.25 ¦ 2.1000 ¦   170.0 ¦   115.0 ¦  93.0 ¦  0.5000 ¦
   RS1 ¦     25 ¦   0.25 ¦ 2.1000 ¦   170.0 ¦   116.0 ¦  97.0 ¦  0.5000 ¦
     2 ¦     25 ¦   0.25 ¦ 2.1000 ¦   170.0 ¦   116.0 ¦  97.0 ¦  0.5000 ¦
     3 ¦     25 ¦   0.25 ¦ 2.1000 ¦   170.0 ¦   116.0 ¦  97.0 ¦  0.5000 ¦
     4 ¦     25 ¦   0.21 ¦ 1.8000 ¦   170.0 ¦   116.0 ¦  97.0 ¦  0.4583 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦   0.0 ¦  0.0000 ¦
-------+--------+--------+--------+---------+---------+-------+---------¦
TOTALS ¦    200 ¦   1.96 ¦16.5000 ¦  1360.0 ¦   874.0 ¦ 713.0 ¦  3.9583 ¦
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)            dP(avg)   =   0.245

 Avg Orifice Meter Reading (in H2O)    dH(avg)   =   2.062

 Avg Stack Temperature (degF)          T(s avg)  =   170.0

 Average Meter Temperature (degF)      T(m avg)  =    99.2

 Avg SQRT(dP)                                    =   0.495

CALCULATED VALUES

 Meter Volume (std, cu. ft.)           V(m std)  =  150.99

 Stack Gas Water Vapor Proportion      B(wo)     =   0.395

 Mol. Wt., Stack Gas Dry               M(d)      =   29.63

 Mol. Wt., Stack Gas Wet               M(s)      =   25.03

 Abs Stack Pressure (in Hg)            P(s)      =   29.94

 Avg Stack Velocity (ft/sec)           V(s avg)  =    32.6

 Isokineticity (%)                     % I       =    99.3

 Stack Gas STD Vol Flow (dscfm)        Q(s)      =    1060

 Actual Stack Gas Vol Flow (acfm)      Q(a)      =    2089

 Particulate Loading, dry(gr/dscf)     C(s std)  =  0.0000
 Particulate Loading, @7% O2(mg/dscm)C(s std)    =       0
 Particulate Loading, dry @ 7 % O2 (gr/dscf)     =  0.0000

 Particulate Emission Rate(lb/hr)      E(p)      =   0.000
```

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********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                          Performed by:     C.KING
Date:  12-11-87                     Test No./Type:    E12111159MM5 T2
Sample Location: E-DUCT             Start/Stop Time:  1159-1537

PARAMETER                            SYMBOL    VALUE
                                              (calc.)
Nozzle Diameter, Actual (in)        N(d)        0.375
Pitot Tube Correction Factor        C(p)       0.8400
Gas Meter Correction Factor         (alpha)    0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)           R            7.00
        Length (if rectangular)     L        ---------
        Width (if rectangular)      W        ---------
Area of Stack (sq ft)               A(s)     (   1.07 )

# of Sample Points                  #               8
Total Sampling Time (min)           (theta)  ( 200.00 )
Barometric Pressure (in Hg)         P(b)        29.95
Stack Pressure (in H2O)             P(stack)   -0.080
Gas Meter Initial Reading (cu ft)              273.04
Gas Meter Final Reading (cu ft)                430.39
Net Gas Sample Volume (cu ft)       V(m)     ( 157.35 )

Vol of Liquid Collected (ml)        Vl(c)      2319.6
Vol of Liq @ Std. Conds. (scf)      V(w std) (109.184 )
Wt. of Filter Particulate (gm)                 0.0000
Wt. of Probe Wash Particulate (gm)             0.0000
Wt of Combined Particulate (gm)     M(p)     ( 0.0000 )

O2  Concentration (by CEM)          % O2        11.40
CO2 Concentration (by CEM)          % CO2        9.10
CO  Concentration (by CEM)          % CO          0.0
N2  Concentration (by diff.)        % N2     (  79.50 )
--------------------------------------------------------------------------
Sample | dClock |Velocity|Orifice |  Stack   |    Gas   Meter  |SQRT(dP) |
Point  |  Time  |Head, dP|Meter,dH|  Temp    |   Temp  (degF)  |         |
       |        |(in H2O)|(in H2O)| (degF)   |   in   |  out   |         |
-------+--------+--------+--------+----------+--------+--------+---------|
   RS4|      25 |   0.25 | 2.1000 |    170.0 |   83.0 |   70.0 |  0.5000 |
     3 |     25 |   0.25 | 2.1000 |    170.0 |  115.0 |   84.0 |  0.5000 |
     2 |     25 |   0.25 | 2.1000 |    170.0 |  120.0 |   93.0 |  0.5000 |
     1 |     25 |   0.25 | 2.1000 |    170.0 |  121.0 |   97.0 |  0.5000 |
    T1 |     25 |   0.25 | 2.1000 |    170.0 |  103.0 |   91.0 |  0.5000 |
     2 |     25 |   0.20 | 1.7000 |    170.0 |  123.0 |  100.0 |  0.4472 |
     3 |     25 |   0.18 | 1.5000 |    170.0 |  120.0 |  100.0 |  0.4243 |
     4 |     25 |   0.18 | 1.5000 |    170.0 |  120.0 |  100.0 |  0.4243 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
-------+--------+--------+--------+----------+--------+--------+---------|
TOTALS |    200 |   1.81 |15.2000 |   1360.0 |  905.0 |  735.0 |  3.7957 |
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)          dP(avg)  =   0.226

 Avg Orifice Meter Reading (in H2O)  dH(avg)  =   1.900

 Avg Stack Temperature (degF)        T(s avg) =   170.0

 Average Meter Temperature (degF)    T(m avg) =   102.5

 Avg SQRT(dP)                                 =   0.474

CALCULATED VALUES

 Meter Volume (std, cu. ft.)         V(m std) =  146.99

 Stack Gas Water Vapor Proportion    B(wo)    =   0.426

 Mol. Wt., Stack Gas Dry             M(d)     =   29.91

 Mol. Wt., Stack Gas Wet             M(s)     =   24.83

 Abs Stack Pressure (in Hg)          P(s)     =   29.94

 Avg Stack Velocity (ft/sec)         V(s avg) =    31.4

 Isokineticity (%)                   % I      =   105.9

 Stack Gas STD Vol Flow (dscfm)      Q(s)     =     968

 Actual Stack Gas Vol Flow (acfm)    Q(a)     =    2011

 Particulate Loading, dry(gr/dscf)   C(s std) =  0.0000
 Particulate Loading, @7% O2(mg/dscm)C(s std) =       0
 Particulate Loading, dry @ 7 % O2 (gr/dscf)  =  0.0000

 Particulate Emission Rate(lb/hr)    E(p)     =   0.000
```

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********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                             Performed by:      G.HILL
Date:  12-11-87                        Test No./Type:     S121111SBMM5
Sample Location: STACK                 Start/Stop Time:   1158-1602

PARAMETER                              SYMBOL      VALUE
                                                   (calc.)
Nozzle Diameter, Actual (in)           N(d)          0.375
Pitot Tube Correction Factor           C(p)         0.8400
Gas Meter Correction Factor            (alpha)      1.0000
Stack (Duct) Dimensions (in):
        Radius (if round)              R              7.00
        Length (if rectangular)        L          --------
        Width (if rectangular)         W          --------
Area of Stack (sq ft)                  A(s)      (    1.07 )

# of Sample Points                     #                12
Total Sampling Time (min)              (theta)   ( 240.00 )
Barometric Pressure (in Hg)            P(b)          29.95
Stack Pressure (in H2O)                P(stack)     -0.080
Gas Meter Initial Reading (cu ft)                   487.93
Gas Meter Final Reading (cu ft)                     685.41
Net Gas Sample Volume (cu ft)          V(m)      ( 197.49 )

Vol of Liquid Collected (ml)           Vl(c)        2677.4
Vol of Liq @ Std. Conds. (scf)         V(w std)  (126.025 )
Wt. of Filter Particulate (gm)                      0.0000
Wt. of Probe Wash Particulate (gm)                  0.0000
Wt of Combined Particulate (gm)        M(p)      ( 0.0000 )

O2  Concentration (by CEM)             % O2          13.78
CO2 Concentration (by CEM)             % CO2          6.72
CO  Concentration (by CEM)             % CO            0.0
N2  Concentration (by diff.)           % N2      (   79.50 )
--------------------------------------------------------------------------
Sample | dClock |Velocity|Orifice |  Stack   |   Gas  Meter    |SQRT(dP) |
Point  |  Time  |Head, dP|Meter,dH|  Temp    |  Temp  (degF)   |         |
       |        |(in H2O)|(in H2O)| (degF)   |   in   |  out   |         |
-------+--------+--------+--------+----------+--------+--------+---------|
     1 |     20 |   0.12 | 0.9600 |    169.0 |   81.0 |   72.0 |  0.3464 |
     2 |     20 |   0.28 | 2.2400 |    169.0 |  109.0 |   79.0 |  0.5292 |
     3 |     20 |   0.28 | 2.2400 |    169.0 |  119.0 |   90.0 |  0.5292 |
     4 |     20 |   0.26 | 2.0800 |    169.0 |  124.0 |   97.0 |  0.5099 |
     5 |     20 |   0.28 | 2.2400 |    169.0 |  125.0 |  100.0 |  0.5292 |
     6 |     20 |   0.30 | 2.4000 |    169.0 |  120.0 |   99.0 |  0.5477 |
     1 |     20 |   0.30 | 2.4000 |    169.0 |  121.0 |   99.0 |  0.5477 |
     2 |     20 |   0.30 | 2.4000 |    169.0 |  124.0 |  100.0 |  0.5477 |
     3 |     20 |   0.30 | 2.4000 |    169.0 |  125.0 |   99.0 |  0.5477 |
     4 |     20 |   0.28 | 2.2400 |    169.0 |  121.0 |  100.0 |  0.5292 |
     5 |     20 |   0.28 | 2.2400 |    169.0 |  120.0 |   99.0 |  0.5292 |
     6 |     20 |   0.28 | 2.2400 |    169.0 |  116.0 |   97.0 |  0.5292 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |    0.0 |    0.0 |  0.0000 |
-------+--------+--------+--------+----------+--------+--------+---------|
TOTALS |    240 |   3.26 |26.0800 |   2028.0 | 1405.0 | 1131.0 |  6.2221 |

FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)               dP(avg)    =    0.272

 Avg Orifice Meter Reading (in H2O)       dH(avg)    =    2.173

 Avg Stack Temperature (degF)             T(s avg)   =    169.0

 Average Meter Temperature (degF)         T(m avg)   =    105.7

 Avg SQRT(dP)                                        =    0.519

CALCULATED VALUES

 Meter Volume (std, cu. ft.)              V(m std)   =   185.43

 Stack Gas Water Vapor Proportion         B(wo)      =    0.405

 Mol. Wt., Stack Gas Dry                  M(d)       =    29.63

 Mol. Wt., Stack Gas Wet                  M(s)       =    24.92

 Abs Stack Pressure (in Hg)               P(s)       =    29.94

 Avg Stack Velocity (ft/sec)              V(s avg)   =     34.2

 Isokineticity (%)                        % I        =     98.3

 Stack Gas STD Vol Flow (dscfm)           Q(s)       =     1097

 Actual Stack Gas Vol Flow (acfm)         Q(a)       =     2193

 Particulate Loading, dry(gr/dscf)        C(s std)   =   0.0000
 Particulate Loading, @7% O2(mg/dscm)C(s std)        =        0
 Particulate Loading, dry @ 7 % O2 (gr/dscf)         =   0.0000

 Particulate Emission Rate(lb/hr)         E(p)       =    0.000
```

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********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                          Performed by:      G.HILL
Date:  12-11-87                     Test No./Type:     S121111SOMS
Sample Location: STACK              Start/Stop Time:   1150-1303

PARAMETER                           SYMBOL       VALUE
                                                 (calc.)
Nozzle Diameter, Actual (in)        N(d)          0.375
Pitot Tube Correction Factor        C(p)          0.8400
Gas Meter Correction Factor         (alpha)       0.9700
Stack (Duct) Dimensions (in):
        Radius (if round)           R              7.00
        Length (if rectangular)     L           --------
        Width (if rectangular)      W           --------
Area of Stack (sq ft)               A(s)      (   1.07 )

# of Sample Points                  #                12
Total Sampling Time (min)           (theta)   (  60.00 )
Barometric Pressure (in Hg)         P(b)          29.95
Stack Pressure (in H2O)             P(stack)     -0.080
Gas Meter Initial Reading (cu ft)               104.46
Gas Meter Final Reading (cu ft)                 152.99
Net Gas Sample Volume (cu ft)       V(m)      (  48.53 )

Vol of Liquid Collected (ml)        Vl(c)         631.9
Vol of Liq @ Std. Conds. (scf)      V(w std)  ( 29.743 )
Wt. of Filter Particulate (gm)                   0.0053
Wt. of Probe Wash Particulate (gm)               0.0000
Wt of Combined Particulate (gm)     M(p)      ( 0.0053 )

O2  Concentration (by CEM)          % O2          14.24
CO2 Concentration (by CEM)          % CO2          6.26
CO  Concentration (by CEM)          % CO           0.0
N2  Concentration (by diff.)        % N2      (  79.50 )

--------------------------------------------------------------------------------
Sample ! dClock !Velocity!Orifice !  Stack   !    Gas  Meter    !SQRT(dP) !
Point  !  Time  !Head, dP!Meter,dH!  Temp    !   Temp  (degF)   !         !
       !        !(in H2O)!(in H2O)! (degF)   !   in    !  out   !         !
-------+--------+--------+--------+----------+---------+--------+---------!
    E1 !      5 !   0.14 ! 1.2000 !    169.0 !    85.0 !   73.0 !  0.3742 !
     2 !      5 !   0.21 ! 1.8100 !    169.0 !    98.0 !   75.0 !  0.4583 !
     3 !      5 !   0.26 ! 2.2400 !    169.0 !   104.0 !   79.0 !  0.5099 !
     4 !      5 !   0.26 ! 2.2400 !    169.0 !   106.0 !   84.0 !  0.5099 !
     5 !      5 !   0.26 ! 2.2400 !    169.0 !   109.0 !   86.0 !  0.5099 !
     6 !      5 !   0.28 ! 2.4100 !    169.0 !   115.0 !   90.0 !  0.5292 !
    S1 !      5 !   0.28 ! 2.4100 !    169.0 !    98.0 !   88.0 !  0.5292 !
     2 !      5 !   0.26 ! 2.4100 !    169.0 !   120.0 !   92.0 !  0.5099 !
     3 !      5 !   0.28 ! 2.4100 !    169.0 !   123.0 !   93.0 !  0.5292 !
     4 !      5 !   0.28 ! 2.4100 !    169.0 !   125.0 !   94.0 !  0.5292 !
     5 !      5 !   0.28 ! 2.4100 !    169.0 !   126.0 !   95.0 !  0.5292 !
     6 !      5 !   0.28 ! 2.4100 !    169.0 !   127.0 !   95.0 !  0.5292 !
     0 !      0 !   0.00 ! 0.0000 !      0.0 !     0.0 !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !      0.0 !     0.0 !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !      0.0 !     0.0 !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !      0.0 !     0.0 !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !      0.0 !     0.0 !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !      0.0 !     0.0 !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !      0.0 !     0.0 !    0.0 !  0.0000 !
-------+--------+--------+--------+----------+---------+--------+---------!
TOTALS !     60 !   3.07 !26.6000 !   2028.0 !  1336.0 ! 1044.0 !  6.0469 !
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)            dP(avg)   =   0.256

 Avg Orifice Meter Reading (in H2O)    dH(avg)   =   2.217

 Avg Stack Temperature (degF)          T(s avg)  =   169.0

 Average Meter Temperature (degF)      T(m avg)  =    99.2

 Avg SQRT(dP)                                    =   0.504

CALCULATED VALUES

 Meter Volume (std, cu. ft.)           V(m std)  =   44.71

 Stack Gas Water Vapor Proportion      B(wo)     =   0.399

 Mol. Wt., Stack Gas Dry               M(d)      =   29.57

 Mol. Wt., Stack Gas Wet               M(s)      =   24.95

 Abs Stack Pressure (in Hg)            P(s)      =   29.94

 Avg Stack Velocity (ft/sec)           V(s avg)  =    33.2

 Isokineticity (%)                     % I       =    96.7

 Stack Gas STD Vol Flow (dscfm)        Q(s)      =    1074

 Actual Stack Gas Vol Flow (acfm)      Q(a)      =    2130

Particulate Loading, dry(gr/dscf)     C(s std)  =  0.0018
Particulate Loading, @7% O2(mg/dscm)C(s std)  =       9
Particulate Loading, dry @ 7 % O2 (gr/dscf)    =  0.0038

Particulate Emission Rate(lb/hr)      E(p)      =   0.017
```

```
*************************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS          FIELD DATA AVERAGES
Plant: CRF                          Performed by:     C.KING
Date:  12-17-87                     Test No./Type:    E12171145MM5       Avg Velocity Head (in H2O)          dP(avg)   =   0.200
Sample Location: E-DUCT             Start/Stop Time:  1145-1510
                                                                         Avg Orifice Meter Reading (in H2O)  dH(avg)   =   1.700
PARAMETER                            SYMBOL    VALUE
                                               (calc.)                   Avg Stack Temperature (degF)        T(s avg)  =   170.0
Nozzle Diameter, Actual (in)        N(d)        0.375
Pitot Tube Correction Factor        C(p)        0.8400                   Average Meter Temperature (degF)    T(m avg)  =    75.1
Gas Meter Correction Factor         (alpha)     0.9900
Stack (Duct) Dimensions (in):                                            Avg SQRT(dP)                                  =   0.447
        Radius (if round)           R             7.00
        Length (if rectangular)     L         ---------                CALCULATED VALUES
        Width (if rectangular)      W         ---------
Area of Stack (sq ft)               A(s)      (   1.07 )                 Meter Volume (std, cu. ft.)         V(m std)  = 141.61

# of Sample Points                  #               8                    Stack Gas Water Vapor Proportion    B(wo)     =   0.417
Total Sampling Time (min)           (theta)   ( 200.00 )
Barometric Pressure (in Hg)         P(b)        29.95                    Mol. Wt., Stack Gas Dry             M(d)      =   29.40
Stack Pressure (in H2O)             P(stack)    -0.080
Gas Meter Initial Reading (cu ft)               449.37                   Mol. Wt., Stack Gas Wet             M(s)      =   24.65
Gas Meter Final Reading (cu ft)                 593.63
Net Gas Sample Volume (cu ft)       V(m)      ( 144.26 )                 Abs Stack Pressure (in Hg)          P(s)      =   29.94

Vol of Liquid Collected (ml)        Vl(c)      2152.2                    Avg Stack Velocity (ft/sec)         V(s avg)  =    29.7
Vol of Liq @ Std. Conds. (scf)      V(w std) (101.303 )
Wt. of Filter Particulate (gm)                 0.0000                    Isokineticity (%)                   % I       =   106.1
Wt. of Probe Wash Particulate (gm)             0.0000
Wt of Combined Particulate (gm)     M(p)      ( 0.0000 )                 Stack Gas STD Vol Flow (dscfm)      Q(s)      =     931

O2  Concentration (by CEM)          % O2        17.00                    Actual Stack Gas Vol Flow (acfm)    Q(a)      =    1903
CO2 Concentration (by CEM)          % CO2        4.50
CO  Concentration (by CEM)          % CO         0.0                     Particulate Loading, dry(gr/dscf)   C(s std)  = 0.0000
N2  Concentration (by diff.)        % N2      (  78.50 )                 Particulate Loading, @7% O2(mg/dscm)C(s std)  =      0
---------------------------------------------------------------------    Particulate Loading, dry @ 7 % O2 (gr/dscf)   = 0.0000
Sample : dClock :Velocity:Orifice :  Stack  :    Gas  Meter   :SQRT(dP) :
Point  :  Time  :Head, dP:Meter,dH:  Temp   :   Temp  (degF)  :         :Particulate Emission Rate(lb/hr)    E(p)      =   0.000
       :        :(in H2O):(in H2O): (degF)  :    in  :  out   :         :
-------+--------+--------+--------+---------+--------+--------+---------:
     4 :     25 :   0.20 : 1.7000 :   170.0 :   73.0 :   49.0 :  0.4472 :
     3 :     25 :   0.20 : 1.7000 :   170.0 :   89.0 :   56.0 :  0.4472 :
     2 :     25 :   0.20 : 1.7000 :   170.0 :   89.0 :   56.0 :  0.4472 :
     1 :     25 :   0.20 : 1.7000 :   170.0 :   89.0 :   57.0 :  0.4472 :
     1 :     25 :   0.20 : 1.7000 :   170.0 :   88.0 :   56.0 :  0.4472 :
     2 :     25 :   0.20 : 1.7000 :   170.0 :   95.0 :   71.0 :  0.4472 :
     3 :     25 :   0.20 : 1.7000 :   170.0 :   95.0 :   71.0 :  0.4472 :
     4 :     25 :   0.20 : 1.7000 :   170.0 :   96.0 :   71.0 :  0.4472 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :    0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :    0.0 :  0.0000 :
-------+--------+--------+--------+---------+--------+--------+---------:
TOTALS :    200 :   1.60 :13.6000 :  1360.0 :  714.0 :  487.0 :  3.5777 :
```

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*********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                          Performed by:      G.HILL
Date:  12-17-87                     Test No./Type:     S12171145MMS
Sample Location: STACK              Start/Stop Time:   1145-1550

PARAMETER                              SYMBOL     VALUE
                                                  (calc.)
Nozzle Diameter, Actual (in)           N(d)        0.375
Pitot Tube Correction Factor           C(p)        0.8400
Gas Meter Correction Factor            (alpha)     0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)              R            7.00
        Length (if rectangular)        L          --------
        Width (if rectangular)         W          --------
Area of Stack (sq ft)                  A(s)     (   1.07 )

# of Sample Points                     #              12
Total Sampling Time (min)              (theta)  ( 240.00 )
Barometric Pressure (in Hg)            P(b)        29.95
Stack Pressure (in H2O)                P(stack)   -0.080
Gas Meter Initial Reading (cu ft)                 291.85
Gas Meter Final Reading (cu ft)                   456.12
Net Gas Sample Volume (cu ft)          V(m)     ( 164.27 )

Vol of Liquid Collected (ml)           Vl(c)      2625.4
Vol of Liq @ Std. Conds. (scf)         V(w std) (123.579 )
Wt. of Filter Particulate (gm)                     0.0000
Wt. of Probe Wash Particulate (gm)                 0.0000
Wt of Combined Particulate (gm)        M(p)     ( 0.0000 )

O2  Concentration (by CEM)             % O2        17.00
CO2 Concentration (by CEM)             % CO2        4.50
CO  Concentration (by CEM)             % CO         0.0
N2  Concentration (by diff.)           % N2     (  78.50 )
--------------------------------------------------------------------------
Sample ¦ dClock ¦Velocity¦Orifice ¦  Stack   ¦    Gas  Meter    ¦SQRT(dP) ¦
Point  ¦  Time  ¦Head, dP¦Meter,dH¦  Temp    ¦   Temp  (degF)   ¦         ¦
       ¦        ¦(in H2O)¦(in H2O)¦ (degF)   ¦    in   ¦  out   ¦         ¦
-------+--------+--------+--------+----------+---------+--------+---------¦
     1 ¦     20 ¦   0.19 ¦ 1.5200 ¦    169.0 ¦    54.0 ¦   42.0 ¦  0.4359 ¦
     2 ¦     20 ¦   0.19 ¦ 1.5200 ¦    169.0 ¦    83.0 ¦   49.0 ¦  0.4359 ¦
     3 ¦     20 ¦   0.18 ¦ 1.4400 ¦    169.0 ¦    91.0 ¦   59.0 ¦  0.4243 ¦
     4 ¦     20 ¦   0.18 ¦ 1.4400 ¦    169.0 ¦    94.0 ¦   63.0 ¦  0.4243 ¦
     5 ¦     20 ¦   0.20 ¦ 1.6000 ¦    169.0 ¦    92.0 ¦   66.0 ¦  0.4472 ¦
     6 ¦     20 ¦   0.20 ¦ 1.6000 ¦    169.0 ¦    93.0 ¦   65.0 ¦  0.4472 ¦
     1 ¦     20 ¦   0.20 ¦ 1.6000 ¦    169.0 ¦    81.0 ¦   60.0 ¦  0.4472 ¦
     2 ¦     20 ¦   0.20 ¦ 1.6000 ¦    169.0 ¦    94.0 ¦   65.0 ¦  0.4472 ¦
     3 ¦     20 ¦   0.20 ¦ 1.6000 ¦    169.0 ¦    95.0 ¦   66.0 ¦  0.4472 ¦
     4 ¦     20 ¦   0.19 ¦ 1.5200 ¦    169.0 ¦    95.0 ¦   65.0 ¦  0.4359 ¦
     5 ¦     20 ¦   0.19 ¦ 1.5200 ¦    169.0 ¦    95.0 ¦   66.0 ¦  0.4359 ¦
     6 ¦     20 ¦   0.20 ¦ 1.6000 ¦    169.0 ¦    95.0 ¦   66.0 ¦  0.4472 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
-------+--------+--------+--------+----------+---------+--------+---------¦
TOTALS ¦    240 ¦   2.32 ¦18.5600 ¦   2028.0 ¦  1062.0 ¦  732.0 ¦  5.2754 ¦
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FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)              dP(avg)   =   0.193

 Avg Orifice Meter Reading (in H2O)      dH(avg)   =   1.547

 Avg Stack Temperature (degF)            T(s avg)  =   169.0

 Average Meter Temperature (degF)        T(m avg)  =    74.7

 Avg SQRT(dP)                                      =   0.440

CALCULATED VALUES

 Meter Volume (std, cu. ft.)             V(m std)  =  161.28

 Stack Gas Water Vapor Proportion        B(wo)     =   0.434

 Mol. Wt., Stack Gas Dry                 M(d)      =   29.40

 Mol. Wt., Stack Gas Wet                 M(s)      =   24.45

 Abs Stack Pressure (in Hg)              P(s)      =   29.94

 Avg Stack Velocity (ft/sec)             V(s avg)  =    29.3

 Isokineticity (%)                       % I       =   105.0

 Stack Gas STD Vol Flow (dscfm)          Q(s)      =     893

 Actual Stack Gas Vol Flow (acfm)        Q(a)      =    1877

 Particulate Loading, dry(gr/dscf)   C(s std)  =  0.0000
 Particulate Loading, @7% O2(mg/dscm)C(s std)  =       0
 Particulate Loading, dry @ 7 % O2 (gr/dscf)   =  0.0000

 Particulate Emission Rate(lb/hr)    E(p)      =   0.000
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ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                           Performed by:     C. KING
Date:  12-17-87                      Test No./Type:    E12171149M5
Sample Location: E-DUCT              Start/Stop Time:  1149-1257

PARAMETER                            SYMBOL     VALUE
                                                (calc.)
Nozzle Diameter, Actual (in)         N(d)         0.375
Pitot Tube Correction Factor         C(p)        0.8400
Gas Meter Correction Factor          (alpha)     0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)            R             7.00
        Length (if rectangular)      L         --------
        Width (if rectangular)       W         --------
Area of Stack (sq ft)                A(s)      (   1.07 )

# of Sample Points                   #               16
Total Sampling Time (min)            (theta)   (  64.00 )
Barometric Pressure (in Hg)          P(b)         29.95
Stack Pressure (in H2O)              P(stack)    -0.080
Gas Meter Initial Reading (cu ft)                 47.36
Gas Meter Final Reading (cu ft)                   95.46
Net Gas Sample Volume (cu ft)        V(m)      (  48.10 )

Vol of Liquid Collected (ml)         Vl(c)        608.5
Vol of Liq @ Std. Conds. (scf)       V(w std)  ( 28.642 )
Wt. of Filter Particulate (gm)                   0.0082
Wt. of Probe Wash Particulate (gm)               0.0000
Wt of Combined Particulate (gm)      M(p)      ( 0.0082 )

O2  Concentration (by CEM)           % O2         17.00
CO2 Concentration (by CEM)           % CO2         4.50
CO  Concentration (by CEM)           % CO           0.0
N2  Concentration (by diff.)         % N2      (  78.50 )
------------------------------------------------------------------------
Sample : dClock  :Velocity:Orifice :  Stack  :     Gas  Meter     :SQRT(dP) :
Point  :  Time   :Head, dP:Meter,dH:  Temp   :    Temp  (degF)    :         :
       :         :(in H2O):(in H2O): (degF)  :    in   :   out    :         :
-------+---------+--------+--------+---------+---------+----------+---------:
    E1 :       4 :   0.20 : 1.6800 :   170.0 :    47.0 :     43.0 :  0.4472 :
     2 :       4 :   0.20 : 1.6800 :   170.0 :    59.0 :     43.0 :  0.4472 :
     3 :       4 :   0.20 : 1.6800 :   170.0 :    75.0 :     48.0 :  0.4472 :
     4 :       4 :   0.20 : 1.6800 :   170.0 :    76.0 :     51.0 :  0.4472 :
     5 :       4 :   0.20 : 1.6800 :   170.0 :    76.0 :     51.0 :  0.4472 :
     6 :       4 :   0.25 : 2.1200 :   170.0 :    78.0 :     58.0 :  0.5000 :
     7 :       4 :   0.25 : 2.1200 :   170.0 :    83.0 :     60.0 :  0.5000 :
     8 :       4 :   0.20 : 1.6800 :   170.0 :    90.0 :     65.0 :  0.4472 :
     1 :       4 :   0.20 : 1.6800 :   170.0 :    88.0 :     63.0 :  0.4472 :
     2 :       4 :   0.20 : 1.6800 :   170.0 :    88.0 :     63.0 :  0.4472 :
     3 :       4 :   0.20 : 1.6800 :   170.0 :    88.0 :     65.0 :  0.4472 :
     4 :       4 :   0.20 : 1.6800 :   170.0 :    88.0 :     64.0 :  0.4472 :
     5 :       4 :   0.20 : 1.6800 :   170.0 :    88.0 :     64.0 :  0.4472 :
     6 :       4 :   0.25 : 2.1200 :   170.0 :    88.0 :     64.0 :  0.5000 :
     7 :       4 :   0.20 : 1.6800 :   170.0 :    88.0 :     64.0 :  0.4472 :
     8 :       4 :   0.25 : 2.1200 :   170.0 :    88.0 :     64.0 :  0.5000 :
     0 :       0 :   0.00 : 0.0000 :     0.0 :     0.0 :      0.0 :  0.0000 :
     0 :       0 :   0.00 : 0.0000 :     0.0 :     0.0 :      0.0 :  0.0000 :
     0 :       0 :   0.00 : 0.0000 :     0.0 :     0.0 :      0.0 :  0.0000 :
-------+---------+--------+--------+---------+---------+----------+---------:
TOTALS :      64 :   3.40 :28.6400 :  2720.0 :  1288.0 :    930.0 :  7.3666 :
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FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)          dP(avg)   =   0.213

 Avg Orifice Meter Reading (in H2O)  dH(avg)   =   1.790

 Avg Stack Temperature (degF)        T(s avg)  =   170.0

 Average Meter Temperature (degF)    T(m avg)  =    69.3

 Avg SQRT(dP)                                  =   0.460

CALCULATED VALUES

 Meter Volume (std, cu. ft.)         V(m std)  =   47.74

 Stack Gas Water Vapor Proportion    B(wo)     =   0.375

 Mol. Wt., Stack Gas Dry             M(d)      =   29.40

 Mol. Wt., Stack Gas Wet             M(s)      =   25.13

 Abs Stack Pressure (in Hg)          P(s)      =   29.94

 Avg Stack Velocity (ft/sec)         V(s avg)  =    30.3

 Isokineticity (%)                   % I       =   102.3

 Stack Gas STD Vol Flow (dscfm)      Q(s)      =    1017

 Actual Stack Gas Vol Flow (acfm)    Q(a)      =    1941

 Particulate Loading, dry(gr/dscf)   C(s std)  =  0.0027
 Particulate Loading, @7% O2(mg/dscm)C(s std)  =      21
 Particulate Loading, dry @ 7 % O2 (gr/dscf)   =  0.0093

 Particulate Emission Rate(lb/hr)    E(p)      =   0.023
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ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                         Performed by:      G.HILL
Date:  12-17-87                    Test No./Type:     S12171145M5
Sample Location: STACK             Start/Stop Time:   :1145-1250

PARAMETER                          SYMBOL     VALUE
                                              (calc.)
Nozzle Diameter, Actual (in)       N(d)         0.375
Pitot Tube Correction Factor       C(p)        0.8400
Gas Meter Correction Factor        (alpha)     0.9700
Stack (Duct) Dimensions (in):
        Radius (if round)          R             7.00
        Length (if rectangular)    L         --------
        Width (if rectangular)     W         --------
Area of Stack (sq ft)              A(s)      (   1.07 )

# of Sample Points                 #               12
Total Sampling Time (min)          (theta)   (  60.00 )
Barometric Pressure (in Hg)        P(b)         29.95
Stack Pressure (in H2O)            P(stack)    -0.080
Gas Meter Initial Reading (cu ft)              155.43
Gas Meter Final Reading (cu ft)                196.85
Net Gas Sample Volume (cu ft)      V(m)      (  41.42 )

Vol of Liquid Collected (ml)       Vl(c)        500.4
Vol of Liq @ Std. Conds. (scf)     V(w std)  ( 23.555 )
Wt. of Filter Particulate (gm)                 0.0025
Wt. of Probe Wash Particulate (gm)             0.0300
Wt of Combined Particulate (gm)    M(p)      ( 0.0325 )

O2  Concentration (by CEM)         % O2         17.00
CO2 Concentration (by CEM)         % CO2         4.50
CO  Concentration (by CEM)         % CO           0.0
N2  Concentration (by diff.)       % N2      (  78.50 )
------------------------------------------------------------------------------
Sample | dClock |Velocity|Orifice |  Stack   |    Gas  Meter     |SQRT(dP) |
Point  :  Time  |Head, dP|Meter,dH|  Temp    :   Temp  (degF)    :         |
       :        |(in H2O)|(in H2O)| (degF)   |   in   |  out     |         |
-------+--------+--------+--------+----------+--------+----------+---------|
    E1 :      5 :   0.19 : 1.6300 :   169.0 :   45.0 :    41.0 :  0.4359 :
     2 :      5 :   0.19 : 1.6300 :   169.0 :   57.0 :    42.0 :  0.4359 :
     3 :      5 :   0.18 : 1.5500 :   169.0 :   67.0 :    43.0 :  0.4243 :
     4 :      5 :   0.18 : 1.5500 :   169.0 :   79.0 :    46.0 :  0.4243 :
     5 :      5 :   0.19 : 1.6300 :   169.0 :   84.0 :    49.0 :  0.4359 :
     6 :      5 :   0.19 : 1.6300 :   169.0 :   90.0 :    54.0 :  0.4359 :
    S1 :      5 :   0.18 : 1.5500 :   169.0 :   70.0 :    48.0 :  0.4243 :
     2 :      5 :   0.18 : 1.5500 :   169.0 :   92.0 :    62.0 :  0.4243 :
     3 :      5 :   0.18 : 1.5500 :   169.0 :   99.0 :    63.0 :  0.4243 :
     4 :      5 :   0.19 : 1.6300 :   169.0 :   92.0 :    66.0 :  0.4359 :
     5 :      5 :   0.19 : 1.6300 :   169.0 :   93.0 :    67.0 :  0.4359 :
     6 :      5 :   0.19 : 1.6300 :   169.0 :   94.0 :    68.0 :  0.4359 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :     0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :     0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :     0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :     0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :     0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :     0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :     0.0 :  0.0000 :
-------+--------+--------+--------+----------+--------+----------+---------|
TOTALS :     60 :   2.23 |19.1600 |  2028.0 |  962.0 |   649.0 |  5.1725 |
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FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)             dP(avg)  =   0.186

 Avg Orifice Meter Reading (in H2O)     dH(avg)  =   1.597

 Avg Stack Temperature (degF)           T(s avg) =   169.0

 Average Meter Temperature (degF)       T(m avg) =    67.1

 Avg SQRT(dP)                                    =   0.431

CALCULATED VALUES

 Meter Volume (std, cu. ft.)            V(m std) =   40.43

 Stack Gas Water Vapor Proportion       B(wo)    =   0.368

 Mol. Wt., Stack Gas Dry                M(d)     =   29.40

 Mol. Wt., Stack Gas Wet                M(s)     =   25.20

 Abs Stack Pressure (in Hg)             P(s)     =   29.94

 Avg Stack Velocity (ft/sec)            V(s avg) =    28.3

 Isokineticity (%)                      % I      =    97.7

 Stack Gas STD Vol Flow (dscfm)         Q(s)     =     962

 Actual Stack Gas Vol Flow (acfm)       Q(a)     =    1813

Particulate Loading, dry(gr/dscf)   C(s std) =  0.0124
Particulate Loading, @7% O2(mg/dscm)C(s std) =      99
Particulate Loading, dry @ 7 % O2 (gr/dscf)  =  0.0434

Particulate Emission Rate(lb/hr)    E(p)     =   0.102
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ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                          Performed by:     C.KING
Date:  1-14-88                      Test No./Type:    E0114135BMM5
Sample Location: E-DUCT             Start/Stop Time:  1358-1802

PARAMETER                            SYMBOL     VALUE
                                                (calc.)
Nozzle Diameter, Actual (in)         N(d)        0.375
Pitot Tube Correction Factor         C(p)        0.8400
Gas Meter Correction Factor          (alpha)     0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)            R             7.00
        Length (if rectangular)      L          --------
        Width (if rectangular)       W          --------
Area of Stack (sq ft)                A(s)      (   1.07 )

# of Sample Points                   #               10
Total Sampling Time (min)            (theta)   ( 230.00 )
Barometric Pressure (in Hg)          P(b)         30.05
Stack Pressure (in H2O)              P(stack)    -0.080
Gas Meter Initial Reading (cu ft)                140.03
Gas Meter Final Reading (cu ft)                  310.02
Net Gas Sample Volume (cu ft)        V(m)      ( 170.00 )

Vol of Liquid Collected (ml)         Vl(c)       2420.7
Vol of Liq @ Std. Conds. (scf)       V(w std)  (113.942 )
Wt. of Filter Particulate (gm)                   0.0000
Wt. of Probe Wash Particulate (gm)               0.0000
Wt of Combined Particulate (gm)      M(p)      ( 0.0000 )

O2  Concentration (by CEM)           % O2         15.98
CO2 Concentration (by CEM)           % CO2         6.06
CO  Concentration (by CEM)           % CO          0.0
N2  Concentration (by diff.)         % N2      (  77.96 )
----------------------------------------------------------------------
Sample ! dClock !Velocity!Orifice !  Stack   !   Gas  Meter   !SQRT(dP) !
Point  !  Time  !Head, dP!Meter,dH!  Temp    !   Temp  (degF) !         !
       !        !(in H2O)!(in H2O)! (degF)   !   in   !  out  !         !
-------+--------+--------+--------+----------+--------+-------+---------!
     4 !     25 !   0.20 ! 1.6800 !   168.0  !   80.0 !  71.0 !  0.4472 !
     3 !     25 !   0.20 ! 1.6800 !   168.0  !   90.0 !  73.0 !  0.4472 !
     2 !     25 !   0.20 ! 1.6800 !   168.0  !   89.0 !  74.0 !  0.4472 !
     1 !     25 !   0.17 ! 1.4300 !   168.0  !   95.0 !  78.0 !  0.4123 !
     1 !     25 !   0.17 ! 1.4300 !   168.0  !   95.0 !  78.0 !  0.4123 !
     2 !     25 !   0.17 ! 1.4300 !   168.0  !   93.0 !  78.0 !  0.4123 !
     3 !     25 !   0.20 ! 1.7000 !   168.0  !   93.0 !  78.0 !  0.4472 !
     4 !     25 !   0.20 ! 1.7000 !   168.0  !   93.0 !  78.0 !  0.4472 !
     1 !     25 !   0.20 ! 1.7000 !   168.0  !   88.0 !  75.0 !  0.4472 !
     2 !      5 !   0.20 ! 1.7000 !   168.0  !   88.0 !  75.0 !  0.4472 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0 !   0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0 !   0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0 !   0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0 !   0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0 !   0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0 !   0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0 !   0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0 !   0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0  !    0.0 !   0.0 !  0.0000 !
-------+--------+--------+--------+----------+--------+-------+---------!
TOTALS !    230 !   1.91 !16.1300 !  1680.0  !  904.0 ! 758.0 !  4.3674 !
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FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)               dP(avg)   =   0.191

 Avg Orifice Meter Reading (in H2O)       dH(avg)   =   1.613

 Avg Stack Temperature (degF)             T(s avg)  =   168.0

 Average Meter Temperature (degF)         T(m avg)  =    83.1

 Avg SQRT(dP)                                       =   0.437

CALCULATED VALUES

 Meter Volume (std, cu. ft.)              V(m std)  =  164.91

 Stack Gas Water Vapor Proportion         B(wo)     =   0.409

 Mol. Wt., Stack Gas Dry                  M(d)      =   29.61

 Mol. Wt., Stack Gas Wet                  M(s)      =   24.87

 Abs Stack Pressure (in Hg)               P(s)      =   30.04

 Avg Stack Velocity (ft/sec)              V(s avg)  =    28.8

 Isokineticity (%)                        % I       =   108.6

 Stack Gas STD Vol Flow (dscfm)           Q(s)      =     921

 Actual Stack Gas Vol Flow (acfm)         Q(a)      =    1844

 Particulate Loading, dry(gr/dscf)        C(s std)  =  0.0000
 Particulate Loading, @7% O2(mg/dscm)C(s std)       =       0
 Particulate Loading, dry @ 7 % O2 (gr/dscf)        =  0.0000

 Particulate Emission Rate(lb/hr)         E(p)      =   0.000
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ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                          Performed by:      B.HILL
Date:  1-14-88                      Test No./Type:     501141400MM5
Sample Location: STACK              Start/Stop Time:   1400-1805

PARAMETER                             SYMBOL      VALUE
                                                  (calc.)
Nozzle Diameter, Actual (in)          N(d)         0.375
Pitot Tube Correction Factor          C(p)         0.8400
Gas Meter Correction Factor           (alpha)      0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)             R             7.00
        Length (if rectangular)       L          ---------
        Width (if rectangular)        W          ---------
Area of Stack (sq ft)                 A(s)       (   1.07 )

# of Sample Points                    #               15
Total Sampling Time (min)             (theta)    ( 229.00 )
Barometric Pressure (in Hg)           P(b)          30.05
Stack Pressure (in H2O)               P(stack)     -0.080
Gas Meter Initial Reading (cu ft)                  851.85
Gas Meter Final Reading (cu ft)                   1043.87
Net Gas Sample Volume (cu ft)         V(m)       ( 192.02 )

Vol of Liquid Collected (ml)          Vl(c)        2786.6
Vol of Liq @ Std. Conds. (scf)        V(w std)   (131.164 )
Wt. of Filter Particulate (gm)                     0.0000
Wt. of Probe Wash Particulate (gm)                 0.0000
Wt of Combined Particulate (gm)       M(p)       ( 0.0000 )

O2  Concentration (by CEM)            % O2          15.98
CO2 Concentration (by CEM)            % CO2          6.06
CO  Concentration (by CEM)            % CO           0.0
N2  Concentration (by diff.)          % N2       (  77.96 )
------------------------------------------------------------------------------
Sample ! dClock !Velocity!Orifice !  Stack   !    Gas  Meter    !SQRT(dP) !
Point  !  Time  !Head, dP!Meter,dH!  Temp    !    Temp  (degF)  !         !
       !        !(in H2O)!(in H2O)! (degF)   !    in   !  out   !         !
-------+--------+--------+--------+----------+---------+--------+---------!
     1 !      8 !   0.28 ! 2.2400 !    170.0 !    44.0 !   37.0 !  0.5292 !
     1 !     12 !   0.28 ! 2.2400 !    170.0 !    61.0 !   43.0 !  0.5292 !
     2 !      3 !   0.28 ! 2.2400 !    170.0 !    87.0 !   48.0 !  0.5292 !
     2 !     17 !   0.28 ! 2.2400 !    170.0 !    85.0 !   51.0 !  0.5292 !
     3 !     20 !   0.28 ! 2.2400 !    170.0 !    97.0 !   58.0 !  0.5292 !
     4 !     20 !   0.25 ! 2.2400 !    170.0 !    98.0 !   64.0 !  0.5000 !
     5 !     20 !   0.29 ! 2.2400 !    170.0 !    99.0 !   66.0 !  0.5385 !
     6 !     20 !   0.29 ! 2.0000 !    170.0 !   100.0 !   68.0 !  0.5385 !
     1 !     16 !   0.29 ! 2.3200 !    170.0 !   101.0 !   70.0 !  0.5385 !
     1 !      4 !   0.29 ! 2.3200 !    170.0 !   100.0 !   68.0 !  0.5385 !
     2 !     20 !   0.28 ! 2.2400 !    170.0 !   101.0 !   70.0 !  0.5292 !
     3 !     20 !   0.28 ! 2.2400 !    170.0 !   102.0 !   70.0 !  0.5292 !
     4 !     20 !   0.28 ! 2.2400 !    170.0 !   102.0 !   70.0 !  0.5292 !
     5 !     20 !   0.28 ! 2.2400 !    170.0 !   102.0 !   70.0 !  0.5292 !
     6 !      9 !   0.28 ! 2.2400 !    170.0 !   102.0 !   70.0 !  0.5292 !
     0 !      0 !   0.00 ! 0.0000 !      0.0 !     0.0 !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !      0.0 !     0.0 !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !      0.0 !     0.0 !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !      0.0 !     0.0 !    0.0 !  0.0000 !
-------+--------+--------+--------+----------+---------+--------+---------!
TOTALS !    229 !   4.21 !33.5200 !   2550.0 !  1381.0 !  923.0 !  7.9456 !
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)            dP(avg)  =   0.281

 Avg Orifice Meter Reading (in H2O)    dH(avg)  =   2.235

 Avg Stack Temperature (degF)          T(s avg) =   170.0

 Average Meter Temperature (degF)      T(m avg) =    76.8

 Avg SQRT(dP)                                   =   0.530

CALCULATED VALUES

 Meter Volume (std, cu. ft.)           V(m std) =  188.75

 Stack Gas Water Vapor Proportion      B(wo)    =   0.410

 Mol. Wt., Stack Gas Dry               M(d)     =   29.61

 Mol. Wt., Stack Gas Wet               M(s)     =   24.85

 Abs Stack Pressure (in Hg)            P(s)     =   30.04

 Avg Stack Velocity (ft/sec)           V(s avg) =    34.9

 Isokineticity (%)                     % I      =   103.3

 Stack Gas STD Vol Flow (dscfm)        Q(s)     =    1113

 Actual Stack Gas Vol Flow (acfm)      Q(a)     =    2241

 Particulate Loading, dry(gr/dscf)     C(s std) =  0.0000
 Particulate Loading, @7% O2(mg/dscm)C(s std)  =       0
 Particulate Loading, dry @ 7 % O2 (gr/dscf)   =  0.0000

 Particulate Emission Rate(lb/hr)      E(p)     =   0.000
```

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********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF
Date:  1-14-88                 Performed by:     C. KING
Sample Location: E-DUCT        Test No./Type:    E01141445M5
                               Start/Stop Time:  1445-1549

PARAMETER                          SYMBOL     VALUE
                                              (calc.)
Nozzle Diameter, Actual (in)       N(d)        0.375
Pitot Tube Correction Factor       C(p)        0.8400
Gas Meter Correction Factor        (alpha)     0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)          R             7.00
        Length (if rectangular)    L          --------
        Width (if rectangular)     W          --------
Area of Stack (sq ft)              A(s)     (    1.07 )

# of Sample Points                 #               16
Total Sampling Time (min)          (theta)  (   64.00 )
Barometric Pressure (in Hg)        P(b)         30.05
Stack Pressure (in H20)            P(stack)    -0.080
Gas Meter Initial Reading (cu ft)              503.70
Gas Meter Final Reading (cu ft)                550.70
Net Gas Sample Volume (cu ft)      V(m)     (   47.00 )

Vol of Liquid Collected (ml)       Vl(c)        567.3
Vol of Liq @ Std. Conds. (scf)     V(w std) ( 26.703 )
Wt. of Filter Particulate (gm)                 0.0107
Wt. of Probe Wash Particulate (gm)             0.0000
Wt of Combined Particulate (gm)    M(p)     ( 0.0107 )

O2  Concentration (by CEM)         % O2         16.57
CO2 Concentration (by CEM)         % CO2         4.64
CO  Concentration (by CEM)         % CO           0.0
N2  Concentration (by diff.)       % N2     (   78.79 )
----------------------------------------------------------------
Sample ¦ dClock ¦Velocity¦Orifice ¦  Stack  ¦    Gas  Meter   ¦SQRT(dP) ¦
Point  ¦  Time  ¦Head, dP¦Meter,dH¦  Temp   ¦   Temp  (degF)  ¦         ¦
       ¦        ¦(in H20)¦(in H20)¦ (degF)  ¦    in   ¦  out  ¦         ¦
-------+--------+--------+--------+---------+---------+-------+---------¦
    E1 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    50.0 ¦  40.0 ¦  0.4472 ¦
     2 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    56.0 ¦  40.0 ¦  0.4472 ¦
     3 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    65.0 ¦  42.0 ¦  0.4472 ¦
     4 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    78.0 ¦  46.0 ¦  0.4472 ¦
     5 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    90.0 ¦  55.0 ¦  0.4472 ¦
     6 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    92.0 ¦  70.0 ¦  0.4472 ¦
     7 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    92.0 ¦  70.0 ¦  0.4472 ¦
     8 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    92.0 ¦  70.0 ¦  0.4472 ¦
     1 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    92.0 ¦  70.0 ¦  0.4472 ¦
     2 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    92.0 ¦  70.0 ¦  0.4472 ¦
     3 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    92.0 ¦  70.0 ¦  0.4472 ¦
     4 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    92.0 ¦  70.0 ¦  0.4472 ¦
     5 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    92.0 ¦  70.0 ¦  0.4472 ¦
     6 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    92.0 ¦  70.0 ¦  0.4472 ¦
     7 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    92.0 ¦  70.0 ¦  0.4472 ¦
     8 ¦      4 ¦   0.20 ¦ 1.6800 ¦   168.0 ¦    92.0 ¦  70.0 ¦  0.4472 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦   0.0 ¦  0.0000 ¦
-------+--------+--------+--------+---------+---------+-------+---------¦
TOTALS ¦     64 ¦   3.20 ¦26.8800 ¦  2688.0 ¦  1351.0 ¦ 993.0 ¦  7.1554 ¦
```

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FIELD DATA AVERAGES

 Avg Velocity Head (in H20)           dP(avg)   =   0.200

 Avg Orifice Meter Reading (in H20)   dH(avg)   =   1.680

 Avg Stack Temperature (degF)         T(s avg)  =   168.0

 Average Meter Temperature (degF)     T(m avg)  =    73.2

 Avg SQRT(dP)                                   =   0.447

CALCULATED VALUES

 Meter Volume (std, cu. ft.)          V(m std)  =   46.44

 Stack Gas Water Vapor Proportion     B(wo)     =   0.365

 Mol. Wt., Stack Gas Dry              M(d)      =   29.41

 Mol. Wt., Stack Gas Wet              M(s)      =   25.24

 Abs Stack Pressure (in Hg)           P(s)      =   30.04

 Avg Stack Velocity (ft/sec)          V(s avg)  =    29.2

 Isokineticity (%)                    % I       =   100.7

 Stack Gas STD Vol Flow (dscfm)       Q(s)      =    1005

 Actual Stack Gas Vol Flow (acfm)     Q(a)      =    1875

Particulate Loading, dry(gr/dscf)     C(s std)  =  0.0036
Particulate Loading, @7% O2(mg/dscm)C(s std)    =      26
Particulate Loading, dry @ 7 % O2 (gr/dscf)     =  0.0112

Particulate Emission Rate(lb/hr)      E(p)      =   0.031
```

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********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                                Performed by:      B.HILL
Date:  1-14-88                            Test No./Type:     S01141435M5
Sample Location: STACK                    Start/Stop Time:   1435-1541

PARAMETER                                  SYMBOL     VALUE
                                                      (calc.)
Nozzle Diameter, Actual (in)               N(d)        0.375
Pitot Tube Correction Factor               C(p)        0.8400
Gas Meter Correction Factor                (alpha)     0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)                  R            7.00
        Length (if rectangular)            L          --------
        Width (if rectangular)             W          --------
Area of Stack (sq ft)                      A(s)      (   1.07 )

# of Sample Points                         #              13
Total Sampling Time (min)                  (theta)   (  60.00 )
Barometric Pressure (in Hg)                P(b)        30.05
Stack Pressure (in H2O)                    P(stack)    -0.080
Gas Meter Initial Reading (cu ft)                      829.01
Gas Meter Final Reading (cu ft)                        877.92
Net Gas Sample Volume (cu ft)              V(m)      (  48.91 )

Vol of Liquid Collected (ml)               Vl(c)       635.1
Vol of Liq @ Std. Conds. (scf)             V(w std)  ( 29.894 )
Wt. of Filter Particulate (gm)                         0.0060
Wt. of Probe Wash Particulate (gm)                     0.0200
Wt of Combined Particulate (gm)            M(p)      ( 0.0260 )

O2  Concentration (by CEM)                 % O2         16.57
CO2 Concentration (by CEM)                 % CO2         4.64
CO  Concentration (by CEM)                 % CO          0.0
N2  Concentration (by diff.)               % N2      (  78.79 )
--------------------------------------------------------------------------
Sample ¦ dClock ¦Velocity¦Orifice ¦  Stack   ¦   Gas   Meter   ¦SQRT(dP) ¦
Point  ¦  Time  ¦Head, dP¦Meter,dH¦  Temp    ¦  Temp   (degF)  ¦         ¦
       ¦        ¦(in H2O)¦(in H2O)¦ (degF)   ¦   in   ¦  out   ¦         ¦
-------+--------+--------+--------+----------+--------+--------+---------¦
    E1 ¦      1 ¦   0.30 ¦ 2.5500 ¦    170.0 ¦   53.0 ¦   40.0 ¦  0.5477 ¦
     1 ¦      4 ¦   0.30 ¦ 2.5500 ¦    170.0 ¦   53.0 ¦   40.0 ¦  0.5477 ¦
     2 ¦      5 ¦   0.30 ¦ 2.5500 ¦    170.0 ¦   67.0 ¦   42.0 ¦  0.5477 ¦
     3 ¦      5 ¦   0.30 ¦ 2.5500 ¦    170.0 ¦   78.0 ¦   44.0 ¦  0.5477 ¦
     4 ¦      5 ¦   0.25 ¦ 2.1300 ¦    170.0 ¦   85.0 ¦   50.0 ¦  0.5000 ¦
     5 ¦      5 ¦   0.25 ¦ 2.1300 ¦    170.0 ¦   86.0 ¦   53.0 ¦  0.5000 ¦
     6 ¦      5 ¦   0.25 ¦ 2.1300 ¦    170.0 ¦   90.0 ¦   55.0 ¦  0.5000 ¦
     1 ¦      5 ¦   0.25 ¦ 2.1300 ¦    170.0 ¦   88.0 ¦   51.0 ¦  0.5000 ¦
     2 ¦      5 ¦   0.25 ¦ 2.1300 ¦    170.0 ¦   92.0 ¦   55.0 ¦  0.5000 ¦
     3 ¦      5 ¦   0.25 ¦ 2.1300 ¦    170.0 ¦   94.0 ¦   70.0 ¦  0.5000 ¦
     4 ¦      5 ¦   0.25 ¦ 2.1300 ¦    170.0 ¦   95.0 ¦   70.0 ¦  0.5000 ¦
     5 ¦      5 ¦   0.28 ¦ 2.3800 ¦    170.0 ¦   95.0 ¦   70.0 ¦  0.5292 ¦
     6 ¦      5 ¦   0.28 ¦ 2.3800 ¦    170.0 ¦   96.0 ¦   74.0 ¦  0.5292 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦    0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦    0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦    0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦    0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦    0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦    0.0 ¦    0.0 ¦  0.0000 ¦
-------+--------+--------+--------+----------+--------+--------+---------¦
TOTALS ¦     60 ¦   3.51 ¦29.8700 ¦   2210.0 ¦ 1072.0 ¦  714.0 ¦  6.7492 ¦
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FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)              dP(avg)   =   0.270

 Avg Orifice Meter Reading (in H2O)      dH(avg)   =   2.298

 Avg Stack Temperature (degF)            T(s avg)  =   170.0

 Average Meter Temperature (degF)        T(m avg)  =    68.7

 Avg SQRT(dP)                                      =   0.519

CALCULATED VALUES

 Meter Volume (std, cu. ft.)             V(m std)  =   48.82

 Stack Gas Water Vapor Proportion        B(wo)     =   0.380

 Mol. Wt., Stack Gas Dry                 M(d)      =   29.41

 Mol. Wt., Stack Gas Wet                 M(s)      =   25.07

 Abs Stack Pressure (in Hg)              P(s)      =   30.04

 Avg Stack Velocity (ft/sec)             V(s avg)  =    34.1

 Isokineticity (%)                       % I       =    99.4

 Stack Gas STD Vol Flow (dscfm)          Q(s)      =    1141

 Actual Stack Gas Vol Flow (acfm)        Q(a)      =    2187

 Particulate Loading, dry(gr/dscf)       C(s std)  =  0.0082
 Particulate Loading, @7% O2(mg/dscm)C(s std)      =      59
 Particulate Loading, dry @ 7 % O2 (gr/dscf)       =  0.0260

¦Particulate Emission Rate(lb/hr)        E(p)      =   0.080
```

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*********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF
Date:  01-20-88 T1                   Performed by:      C.KING
Sample Location: E-DUCT              Test No./Type:     E01201535MM5T1
                                     Start/Stop Time:   1535-2102
PARAMETER
                                       SYMBOL      VALUE
                                                   (calc.)
Nozzle Diameter, Actual (in)           N(d)          0.357
Pitot Tube Correction Factor           C(p)         0.8400
Gas Meter Correction Factor            (alpha)      0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)              R              7.00
        Length (if rectangular)        L          --------
        Width (if rectangular)         W          --------
Area of Stack (sq ft)                  A(s)      (   1.07 )

# of Sample Points                     #                13
Total Sampling Time (min)              (theta)   ( 275.00 )
Barometric Pressure (in Hg)            P(b)          30.05
Stack Pressure (in H2O)                P(stack)     -0.080
Gas Meter Initial Reading (cu ft)                   686.36
Gas Meter Final Reading (cu ft)                     856.52
Net Gas Sample Volume (cu ft)          V(m)      ( 170.17 )

Vol of Liquid Collected (ml)           Vl(c)        2650.0
Vol of Liq @ Std. Conds. (scf)         V(w std)  (124.736 )
Wt. of Filter Particulate (gm)                      0.0000
Wt. of Probe Wash Particulate (gm)                  0.0000
Wt of Combined Particulate (gm)        M(p)      ( 0.0000 )

O2  Concentration (by CEM)             % O2          15.57
CO2 Concentration (by CEM)             % CO2          8.15
CO  Concentration (by CEM)             % CO            0.0
N2  Concentration (by diff.)           % N2      (  76.28 )
-----------------------------------------------------------------------------
Sample ! dClock !Velocity!Orifice !  Stack  !   Gas  Meter   !SQRT(dP) !
Point  !  Time  !Head, dP!Meter,dH!  Temp   !  Temp  (degF)  !         !
       !        !(in H2O)!(in H2O)! (degF)  !   in   !  out  !         !
-------+--------+--------+--------+---------+--------+-------+---------!
     1 !     10 !   0.12 ! 1.0000 !   168.0 !   90.0 !  65.0 !  0.3464 !
     1 !     15 !   0.18 ! 1.5000 !   168.0 !   92.0 !  68.0 !  0.4243 !
     2 !     25 !   0.18 ! 1.5000 !   168.0 !   93.0 !  70.0 !  0.4243 !
     3 !     25 !   0.18 ! 1.5000 !   168.0 !   93.0 !  71.0 !  0.4243 !
     4 !     25 !   0.18 ! 1.5000 !   168.0 !   93.0 !  71.0 !  0.4243 !
     4 !     25 !   0.20 ! 1.6800 !   168.0 !   93.0 !  71.0 !  0.4472 !
     3 !     10 !   0.20 ! 1.6800 !   168.0 !   93.0 !  71.0 !  0.4472 !
     3 !     15 !   0.25 ! 2.1000 !   168.0 !   93.0 !  71.0 !  0.5000 !
     2 !     25 !   0.25 ! 2.1000 !   168.0 !   93.0 !  71.0 !  0.5000 !
     1 !     25 !   0.25 ! 2.1000 !   168.0 !   93.0 !  71.0 !  0.5000 !
     1 !     25 !   0.21 ! 1.8000 !   168.0 !   93.0 !  71.0 !  0.4626 !
     2 !     25 !   0.20 ! 1.7000 !   168.0 !   93.0 !  71.0 !  0.4472 !
     3 !     25 !   0.18 ! 1.5000 !   168.0 !   93.0 !  71.0 !  0.4243 !
     0 !      0 !   0.00 ! 0.0000 !     0.0 !    0.0 !   0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0 !    0.0 !   0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0 !    0.0 !   0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0 !    0.0 !   0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0 !    0.0 !   0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !     0.0 !    0.0 !   0.0 !  0.0000 !
-------+--------+--------+--------+---------+--------+-------+---------!
TOTALS !    275 !   2.58 !21.6600 !  2184.0 ! 1205.0 ! 913.0 !  5.7720 !
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)               dP(avg)  =    0.199

 Avg Orifice Meter Reading (in H2O)       dH(avg)  =    1.666

 Avg Stack Temperature (degF)             T(s avg) =    168.0

 Average Meter Temperature (degF)         T(m avg) =     81.5

 Avg SQRT(dP)
                                                   =    0.444
CALCULATED VALUES

 Meter Volume (std, cu. ft.)              V(m std) =   165.60

 Stack Gas Water Vapor Proportion         B(wo)    =    0.430

 Mol. Wt., Stack Gas Dry                  M(d)     =    29.93

 Mol. Wt., Stack Gas Wet                  M(s)     =    24.80

 Abs Stack Pressure (in Hg)               P(s)     =    30.04

 Avg Stack Velocity (ft/sec)              V(s avg) =     29.3

 Isokineticity (%)                        % I      =    102.5

 Stack Gas STD Vol Flow (dscfm)           Q(s)     =      904

 Actual Stack Gas Vol Flow (acfm)         Q(a)     =     1877

Particulate Loading, dry(gr/dscf)    C(s std) =  0.0000
Particulate Loading, @7% O2(mg/dscm)C(s std) =        0
Particulate Loading, dry @ 7 % O2 (gr/dscf)  =  0.0000

Particulate Emission Rate(lb/hr)    E(p)     =   0.000
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**********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                           Performed by:      C.KING
Date:  01-20-88 T2                   Test No./Type:     E01201535MM5T2
Sample Location: E-DUCT              Start/Stop Time:   1535-2102

PARAMETER                              SYMBOL     VALUE
                                                  (calc.)
Nozzle Diameter, Actual (in)         N(d)          0.375
Pitot Tube Correction Factor         C(p)         0.8400
Gas Meter Correction Factor          (alpha)      0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)            R              7.00
        Length (if rectangular)      L          --------
        Width (if rectangular)       W          --------
Area of Stack (sq ft)                A(s)      (   1.07 )

# of Sample Points                   #                13
Total Sampling Time (min)            (theta)   ( 275.00 )
Barometric Pressure (in Hg)          P(b)          30.05
Stack Pressure (in H2O)              P(stack)     -0.080
Gas Meter Initial Reading (cu ft)                 381.43
Gas Meter Final Reading (cu ft)                   565.89
Net Gas Sample Volume (cu ft)        V(m)      ( 184.46 )

Vol of Liquid Collected (ml)         Vl(c)        2650.0
Vol of Liq @ Std. Conds. (scf)       V(w std)  (124.736 )
Wt. of Filter Particulate (gm)                    0.0000
Wt. of Probe Wash Particulate (gm)                0.0000
Wt of Combined Particulate (gm)      M(p)      ( 0.0000 )

O2  Concentration (by CEM)           % O2          15.57
CO2 Concentration (by CEM)           % CO2          8.15
CO  Concentration (by CEM)           % CO            0.0
N2  Concentration (by diff.)         % N2      (  76.28 )
--------------------------------------------------------------------------------
Sample | dClock  |Velocity|Orifice |  Stack    |    Gas  Meter     |SQRT(dP) |
Point  |  Time   |Head, dP|Meter,dH|  Temp     |   Temp  (degF)    |         |
       |         |(in H2O)|(in H2O)|  (degF)   |    in   |  out    |         |
-------+---------+--------+--------+-----------+---------+---------+---------|
     4 |      10 |   0.12 | 1.0000 |    168.0  |    91.0 |    65.0 |  0.3464 |
     4 |      15 |   0.18 | 1.5000 |    168.0  |    92.0 |    68.0 |  0.4243 |
     3 |      25 |   0.18 | 1.5000 |    168.0  |    95.0 |    70.0 |  0.4243 |
     2 |      25 |   0.18 | 1.5000 |    168.0  |    95.0 |    71.0 |  0.4243 |
     1 |      25 |   0.18 | 1.5000 |    168.0  |    95.0 |    71.0 |  0.4243 |
     1 |      25 |   0.14 | 1.2000 |    168.0  |    82.0 |    73.0 |  0.3742 |
     2 |      10 |   0.14 | 1.2000 |    168.0  |    95.0 |    73.0 |  0.3742 |
     2 |      15 |   0.17 | 1.4000 |    168.0  |    95.0 |    73.0 |  0.4087 |
     3 |      25 |   0.17 | 1.4000 |    168.0  |    95.0 |    73.0 |  0.4123 |
     4 |      25 |   0.17 | 1.4000 |    168.0  |    95.0 |    73.0 |  0.4123 |
     4 |      25 |   0.17 | 1.4000 |    168.0  |    95.0 |    73.0 |  0.4123 |
     3 |      25 |   0.15 | 1.3000 |    168.0  |    95.0 |    73.0 |  0.3873 |
     2 |      25 |   0.13 | 1.1000 |    168.0  |    95.0 |    73.0 |  0.3606 |
     0 |       0 |   0.00 | 0.0000 |      0.0  |     0.0 |     0.0 |  0.0000 |
     0 |       0 |   0.00 | 0.0000 |      0.0  |     0.0 |     0.0 |  0.0000 |
     0 |       0 |   0.00 | 0.0000 |      0.0  |     0.0 |     0.0 |  0.0000 |
     0 |       0 |   0.00 | 0.0000 |      0.0  |     0.0 |     0.0 |  0.0000 |
     0 |       0 |   0.00 | 0.0000 |      0.0  |     0.0 |     0.0 |  0.0000 |
     0 |       0 |   0.00 | 0.0000 |      0.0  |     0.0 |     0.0 |  0.0000 |
-------+---------+--------+--------+-----------+---------+---------+---------|
TOTALS |     275 |   2.08 |17.4000 |   2184.0  |  1215.0 |   929.0 |  5.1852 |
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)             dP(avg)   =   0.160

 Avg Orifice Meter Reading (in H2O)     dH(avg)   =   1.338

 Avg Stack Temperature (degF)           T(s avg)  =   168.0

 Average Meter Temperature (degF)       T(m avg)  =    82.5

 Avg SQRT(dP)                                     =   0.399

CALCULATED VALUES

 Meter Volume (std, cu. ft.)            V(m std)  =  179.04

 Stack Gas Water Vapor Proportion       B(wo)     =   0.411

 Mol. Wt., Stack Gas Dry                M(d)      =   29.93

 Mol. Wt., Stack Gas Wet                M(s)      =   25.03

 Abs Stack Pressure (in Hg)             P(s)      =   30.04

 Avg Stack Velocity (ft/sec)            V(s avg)  =    26.2

 Isokineticity (%)                      % I       =   108.7

 Stack Gas STD Vol Flow (dscfm)         Q(s)      =     835

 Actual Stack Gas Vol Flow (acfm)       Q(a)      =    1679

Particulate Loading, dry(gr/dscf)    C(s std) =  0.0000
Particulate Loading, @7% O2(mg/dscm)C(s std) =        0
Particulate Loading, dry @ 7 % O2 (gr/dscf)  =   0.0000

Particulate Emission Rate(lb/hr)     E(p)     =   0.000
```

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*********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                            Performed by:     G.HILL
Date:  01-20-88                       Test No./Type:    S01201535MM5
Sample Location: STACK                Start/Stop Time:  1535-2009

PARAMETER                              SYMBOL    VALUE
                                                 (calc.)
Nozzle Diameter, Actual (in)          N(d)        0.375
Pitot Tube Correction Factor          C(p)        0.8400
Gas Meter Correction Factor           (alpha)     0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)             R             7.00
        Length (if rectangular)       L          --------
        Width (if rectangular)        W          --------
Area of Stack (sq ft)                 A(s)      (   1.07 )

# of Sample Points                    #               14
Total Sampling Time (min)             (theta)   ( 260.00 )
Barometric Pressure (in Hg)           P(b)         30.05
Stack Pressure (in H2O)               P(stack)    -0.080
Gas Meter Initial Reading (cu ft)                  44.67
Gas Meter Final Reading (cu ft)                   237.45
Net Gas Sample Volume (cu ft)         V(m)      ( 192.78 )

Vol of Liquid Collected (ml)          Vl(c)      3115.4
Vol of Liq @ Std. Conds. (scf)        V(w std)  (146.642 )
Wt. of Filter Particulate (gm)                    0.0000
Wt. of Probe Wash Particulate (gm)                0.0000
Wt of Combined Particulate (gm)       M(p)      ( 0.0000 )

O2  Concentration (by CEM)            % O2         15.57
CO2 Concentration (by CEM)            % CO2         8.15
CO  Concentration (by CEM)            % CO          0.0
N2  Concentration (by diff.)          % N2      (  76.28 )
---------------------------------------------------------------------------
Sample | dClock |Velocity|Orifice |  Stack   |    Gas  Meter    |SQRT(dP) |
Point  |  Time  |Head, dP|Meter,dH|  Temp    |   Temp  (degF)   |         |
       |        |(in H2O)|(in H2O)| (degF)   |   in    |  out   |         |
-------+--------+--------+--------+----------+---------+--------+---------|
     1 |     10 |   0.27 | 2.1600 |   170.0  |   64.0  |   53.0 |  0.5196 |
     1 |     10 |   0.27 | 2.1600 |   170.0  |   69.0  |   57.0 |  0.5196 |
     2 |     20 |   0.27 | 2.1600 |   170.0  |   85.0  |   59.0 |  0.5196 |
     3 |     20 |   0.27 | 2.1600 |   170.0  |  105.0  |   66.0 |  0.5196 |
     4 |     20 |   0.25 | 2.0000 |   170.0  |  110.0  |   70.0 |  0.5000 |
     5 |     20 |   0.25 | 2.0000 |   170.0  |  111.0  |   72.0 |  0.5000 |
     6 |     20 |   0.25 | 2.0000 |   170.0  |  111.0  |   72.0 |  0.5000 |
     1 |     20 |   0.27 | 2.1600 |   170.0  |   76.0  |   72.0 |  0.5196 |
     2 |     20 |   0.27 | 2.1600 |   170.0  |   96.0  |   74.0 |  0.5196 |
     3 |     20 |   0.27 | 2.1600 |   170.0  |  106.0  |   75.0 |  0.5196 |
     4 |     20 |   0.27 | 2.1600 |   170.0  |  107.0  |   77.0 |  0.5196 |
     5 |     20 |   0.27 | 2.1600 |   170.0  |  108.0  |   77.0 |  0.5196 |
     6 |     20 |   0.25 | 2.0000 |   170.0  |  102.0  |   76.0 |  0.5000 |
     6 |     20 |   0.25 | 2.0000 |   170.0  |  102.0  |   76.0 |  0.5000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0  |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0  |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0  |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0  |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0  |    0.0 |  0.0000 |
-------+--------+--------+--------+----------+---------+--------+---------|
TOTALS |    260 |   3.68 |29.4400 |  2380.0  | 1352.0  |  976.0 |  7.1765 |
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)           dP(avg)   =    0.263

 Avg Orifice Meter Reading (in H2O)   dH(avg)   =    2.103

 Avg Stack Temperature (degF)         T(s avg)  =    170.0

 Average Meter Temperature (degF)     T(m avg)  =     83.1

 Avg SQRT(dP)                                   =    0.513

CALCULATED VALUES

 Meter Volume (std, cu. ft.)          V(m std)  =   187.23

 Stack Gas Water Vapor Proportion     B(wo)     =    0.439

 Mol. Wt., Stack Gas Dry              M(d)      =    29.93

 Mol. Wt., Stack Gas Wet              M(s)      =    24.69

 Abs Stack Pressure (in Hg)           P(s)      =    30.04

 Avg Stack Velocity (ft/sec)          V(s avg)  =     33.9

 Isokineticity (%)                    % I       =     97.8

 Stack Gas STD Vol Flow (dscfm)       Q(s)      =     1027

 Actual Stack Gas Vol Flow (acfm)     Q(a)      =     2176

 Particulate Loading, dry(gr/dscf)    C(s std)  =   0.0000
 Particulate Loading, @7% O2(mg/dscm)C(s std)   =        0
 Particulate Loading, dry @ 7 % O2 (gr/dscf)    =   0.0000

 Particulate Emission Rate(lb/hr)     E(p)      =    0.000
```

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*********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                             Performed by:      G. HILL
Date:  01-20-88                        Test No./Type:     S01201535M5
Sample Location: STACK                 Start/Stop Time:   1535-1700

PARAMETER                               SYMBOL     VALUE
                                                   (calc.)
Nozzle Diameter, Actual (in)           N(d)         0.357
Pitot Tube Correction Factor           C(p)         0.8400
Gas Meter Correction Factor            (alpha)      0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)              R             7.00
        Length (if rectangular)        L          --------
        Width (if rectangular)         W          --------
Area of Stack (sq ft)                  A(s)      (   1.07 )

# of Sample Points                     #               12
Total Sampling Time (min)              (theta)   (  60.00 )
Barometric Pressure (in Hg)            P(b)        30.05
Stack Pressure (in H2O)                P(stack)   -0.080
Gas Meter Initial Reading (cu ft)                   6.08
Gas Meter Final Reading (cu ft)                    47.11
Net Gas Sample Volume (cu ft)          V(m)      (  41.02 )

Vol of Liquid Collected (ml)           Vl(c)       533.0
Vol of Liq @ Std. Conds. (scf)         V(w std)  ( 25.088 )
Wt. of Filter Particulate (gm)                     0.0168
Wt. of Probe Wash Particulate (gm)                 0.0100
Wt of Combined Particulate (gm)        M(p)      ( 0.0268 )

O2  Concentration (by CEM)             % O2        15.57
CO2 Concentration (by CEM)             % CO2        8.15
CO  Concentration (by CEM)             % CO         0.0
N2  Concentration (by diff.)           % N2      (  76.28 )
----------------------------------------------------------------------
Sample ¦ dClock ¦Velocity¦Orifice ¦  Stack   ¦    Gas  Meter    ¦SQRT(dP) ¦
Point  ¦  Time  ¦Head, dP¦Meter,dH¦  Temp    ¦   Temp  (degF)   ¦         ¦
       ¦        ¦(in H2O)¦(in H2O)¦  (degF)  ¦    in   ¦  out   ¦         ¦
-------+--------+--------+--------+----------+---------+--------+---------¦
    E1 ¦      5 ¦   0.17 ¦ 1.4500 ¦    170.0 ¦    96.0 ¦   78.0 ¦  0.4123 ¦
     2 ¦      5 ¦   0.17 ¦ 1.4500 ¦    170.0 ¦    98.0 ¦   77.0 ¦  0.4123 ¦
     3 ¦      5 ¦   0.17 ¦ 1.4500 ¦    170.0 ¦    76.0 ¦   69.0 ¦  0.4123 ¦
     4 ¦      5 ¦   0.17 ¦ 1.4500 ¦    170.0 ¦    87.0 ¦   68.0 ¦  0.4123 ¦
     5 ¦      5 ¦   0.20 ¦ 1.7000 ¦    170.0 ¦    95.0 ¦   68.0 ¦  0.4472 ¦
     6 ¦      5 ¦   0.20 ¦ 1.7000 ¦    170.0 ¦   103.0 ¦   71.0 ¦  0.4472 ¦
     1 ¦      5 ¦   0.20 ¦ 1.7000 ¦    170.0 ¦   108.0 ¦   74.0 ¦  0.4472 ¦
     2 ¦      5 ¦   0.20 ¦ 1.7000 ¦    170.0 ¦   114.0 ¦   79.0 ¦  0.4472 ¦
     3 ¦      5 ¦   0.20 ¦ 1.7000 ¦    170.0 ¦   128.0 ¦   87.0 ¦  0.4472 ¦
     4 ¦      5 ¦   0.19 ¦ 1.6200 ¦    170.0 ¦   125.0 ¦   97.0 ¦  0.4359 ¦
     5 ¦      5 ¦   0.19 ¦ 1.6200 ¦    170.0 ¦   125.0 ¦  100.0 ¦  0.4359 ¦
     6 ¦      5 ¦   0.19 ¦ 1.6200 ¦    170.0 ¦   126.0 ¦  102.0 ¦  0.4359 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
-------+--------+--------+--------+----------+---------+--------+---------¦
TOTALS ¦     60 ¦   2.25 ¦19.1600 ¦   2040.0 ¦  1281.0 ¦  970.0 ¦  5.1930 ¦
```

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FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)            dP(avg)   =   0.188

 Avg Orifice Meter Reading (in H2O)    dH(avg)   =   1.597

 Avg Stack Temperature (degF)          T(s avg)  =   170.0

 Average Meter Temperature (degF)      T(m avg)  =    93.8

 Avg SQRT(dP)                                    =   0.433

CALCULATED VALUES

 Meter Volume (std, cu. ft.)           V(m std)  =   39.03

 Stack Gas Water Vapor Proportion      B(wo)     =   0.391

 Mol. Wt., Stack Gas Dry               M(d)      =   29.93

 Mol. Wt., Stack Gas Wet               M(s)      =   25.26

 Abs Stack Pressure (in Hg)            P(s)      =   30.04

 Avg Stack Velocity (ft/sec)           V(s avg)  =    28.3

 Isokineticity (%)                     % I       =   107.6

 Stack Gas STD Vol Flow (dscfm)        Q(s)      =     930

 Actual Stack Gas Vol Flow (acfm)      Q(a)      =    1816

 Particulate Loading, dry(gr/dscf)     C(s std)  =  0.0106
 Particulate Loading, @7% O2(mg/dscm)C(s std)    =      63
 Particulate Loading, dry @ 7 % O2 (gr/dscf)     =  0.0273

 Particulate Emission Rate(lb/hr)      E(p)      =   0.085
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*********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                           Performed by:      C.KING
Date:  01-21-88T1                    Test No./Type:     E01211240MMST1
Sample Location: E-DUCT              Start/Stop Time:   1240-1630

PARAMETER                             SYMBOL     VALUE
                                                 (calc.)
Nozzle Diameter, Actual (in)          N(d)        0.375
Pitot Tube Correction Factor          C(p)        0.8400
Gas Meter Correction Factor           (alpha)     0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)             R            7.00
        Length (if rectangular)       L          --------
        Width (if rectangular)        W          --------
Area of Stack (sq ft)                 A(s)      (   1.07 )

# of Sample Points                    #               9
Total Sampling Time (min)             (theta)   ( 201.00 )
Barometric Pressure (in Hg)           P(b)        30.05
Stack Pressure (in H2O)               P(stack)   -0.080
Gas Meter Initial Reading (cu ft)                567.34
Gas Meter Final Reading (cu ft)                  734.69
Net Gas Sample Volume (cu ft)         V(m)      ( 167.36 )

Vol of Liquid Collected (ml)          Vl(c)      2250.0
Vol of Liq @ Std. Conds. (scf)        V(w std)  (105.907 )
Wt. of Filter Particulate (gm)                    0.0000
Wt. of Probe Wash Particulate (gm)                0.0000
Wt of Combined Particulate (gm)       M(p)      ( 0.0000 )

O2  Concentration (by CEM)            % O2        16.06
CO2 Concentration (by CEM)            % CO2        8.31
CO  Concentration (by CEM)            % CO         0.0
N2  Concentration (by diff.)          % N2      (  75.63 )
-------------------------------------------------------------------------
Sample ! dClock !Velocity!Orifice !  Stack  !    Gas  Meter    !SQRT(dP) !
Point  !  Time  !Head, dP!Meter,dH!  Temp   !   Temp  (degF)   !         !
       !        !(in H2O)!(in H2O)! (degF)  !    in   !  out   !         !
-------+--------+--------+--------+---------+---------+--------+---------!
     1 !     25 !   0.25 ! 2.1000 !  168.0  !   61.0  !   49.0 !  0.5000 !
     2 !     25 !   0.25 ! 2.1000 !  168.0  !   90.0  !   65.0 !  0.5000 !
     3 !     25 !   0.25 ! 2.1000 !  168.0  !   93.0  !   70.0 !  0.5000 !
     4 !     25 !   0.25 ! 2.1000 !  168.0  !   93.0  !   70.0 !  0.5000 !
     4 !     11 !   0.25 ! 2.1000 !  168.0  !   93.0  !   70.0 !  0.5000 !
     4 !     15 !   0.25 ! 2.1000 !  168.0  !   93.0  !   70.0 !  0.5000 !
     3 !     25 !   0.25 ! 2.1000 !  168.0  !   93.0  !   70.0 !  0.5000 !
     2 !     25 !   0.25 ! 2.1000 !  168.0  !   93.0  !   70.0 !  0.5000 !
     1 !     25 !   0.23 ! 1.9000 !  168.0  !   93.0  !   70.0 !  0.4796 !
     0 !      0 !   0.00 ! 0.0000 !    0.0  !    0.0  !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !    0.0  !    0.0  !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !    0.0  !    0.0  !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !    0.0  !    0.0  !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !    0.0  !    0.0  !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !    0.0  !    0.0  !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !    0.0  !    0.0  !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !    0.0  !    0.0  !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !    0.0  !    0.0  !    0.0 !  0.0000 !
     0 !      0 !   0.00 ! 0.0000 !    0.0  !    0.0  !    0.0 !  0.0000 !
-------+--------+--------+--------+---------+---------+--------+---------!
TOTALS !    201 !   2.23 !18.7000 ! 1512.0  !  802.0  !  604.0 !  4.4796 !
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)              dP(avg)   =   0.248

 Avg Orifice Meter Reading (in H2O)      dH(avg)   =   2.078

 Avg Stack Temperature (degF)            T(s avg)  =   168.0

 Average Meter Temperature (degF)        T(m avg)  =    78.1

 Avg SQRT(dP)
                                                   =   0.498
CALCULATED VALUES

 Meter Volume (std, cu. ft.)             V(m std)  =  164.04

 Stack Gas Water Vapor Proportion        B(wo)     =   0.392

 Mol. Wt., Stack Gas Dry                 M(d)      =   29.97

 Mol. Wt., Stack Gas Wet                 M(s)      =   25.27

 Abs Stack Pressure (in Hg)              P(s)      =   30.04

 Avg Stack Velocity (ft/sec)             V(s avg)  =    32.5

 Isokineticity (%)                       % I       =   106.4

 Stack Gas STD Vol Flow (dscfm)          Q(s)      =    1070

 Actual Stack Gas Vol Flow (acfm)        Q(a)      =    2085

Particulate Loading, dry(gr/dscf)    C(s std) =  0.0000
Particulate Loading, @7% O2(mg/dscm)C(s std) =       0
Particulate Loading, dry @ 7 % O2 (gr/dscf)  =  0.0000

Particulate Emission Rate(lb/hr)     E(p)     =   0.000
```

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*********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                       Performed by:     C.KING
Date:  01-21-88T2                Test No./Type:    E01211240MM5T2
Sample Location: E-DUCT          Start/Stop Time:  1240-1630

PARAMETER                          SYMBOL     VALUE
                                              (calc.)
Nozzle Diameter, Actual (in)       N(d)         0.357
Pitot Tube Correction Factor       C(p)         0.8400
Gas Meter Correction Factor        (alpha)      0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)          R              7.00
        Length (if rectangular)    L          --------
        Width (if rectangular)     W          --------
Area of Stack (sq ft)              A(s)      (    1.07 )

# of Sample Points                 #                 9
Total Sampling Time (min)          (theta)   ( 201.00 )
Barometric Pressure (in Hg)        P(b)         30.05
Stack Pressure (in H2O)            P(stack)    -0.080
Gas Meter Initial Reading (cu ft)             858.90
Gas Meter Final Reading (cu ft)              1008.92
Net Gas Sample Volume (cu ft)      V(m)      ( 150.02 )

Vol of Liquid Collected (ml)       Vl(c)       2137.0
Vol of Liq @ Std. Conds. (scf)     V(w std)  (100.587 )
Wt. of Filter Particulate (gm)                 0.0000
Wt. of Probe Wash Particulate (gm)             0.0000
Wt of Combined Particulate (gm)    M(p)      ( 0.0000 )

O2  Concentration (by CEM)         % O2         16.06
CO2 Concentration (by CEM)         % CO2         8.31
CO  Concentration (by CEM)         % CO          0.0
N2  Concentration (by diff.)       % N2      (  75.63 )
-----------------------------------------------------------------------------
Sample ¦ dClock ¦Velocity¦Orifice ¦  Stack  ¦   Gas   Meter  ¦SQRT(dP) ¦
Point  ¦  Time  ¦Head, dP¦Meter,dH¦  Temp   ¦   Temp  (degF) ¦         ¦
       ¦        ¦(in H2O)¦(in H2O)¦ (degF)  ¦   in   ¦  out  ¦         ¦
-------+--------+--------+--------+---------+--------+-------+---------¦
     4 ¦     25 ¦   0.25 ¦ 2.1000 ¦   168.0 ¦   61.0 ¦  49.0 ¦  0.5000 ¦
     3 ¦     25 ¦   0.25 ¦ 2.1000 ¦   168.0 ¦   90.0 ¦  65.0 ¦  0.5000 ¦
     2 ¦     25 ¦   0.25 ¦ 2.1000 ¦   168.0 ¦   93.0 ¦  70.0 ¦  0.5000 ¦
     1 ¦     25 ¦   0.25 ¦ 2.1000 ¦   168.0 ¦   93.0 ¦  70.0 ¦  0.5000 ¦
     1 ¦     11 ¦   0.25 ¦ 2.1000 ¦   168.0 ¦   93.0 ¦  70.0 ¦  0.5000 ¦
     1 ¦     15 ¦   0.25 ¦ 2.1000 ¦   168.0 ¦   93.0 ¦  70.0 ¦  0.5000 ¦
     2 ¦     25 ¦   0.25 ¦ 2.1000 ¦   168.0 ¦   93.0 ¦  70.0 ¦  0.5000 ¦
     3 ¦     25 ¦   0.25 ¦ 2.1000 ¦   168.0 ¦   93.0 ¦  70.0 ¦  0.5000 ¦
     4 ¦     25 ¦   0.25 ¦ 2.1000 ¦   168.0 ¦   93.0 ¦  70.0 ¦  0.5000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦    0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦    0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦    0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦    0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦    0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦    0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦    0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦    0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦    0.0 ¦   0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦    0.0 ¦   0.0 ¦  0.0000 ¦
-------+--------+--------+--------+---------+--------+-------+---------¦
TOTALS ¦    201 ¦   2.25 ¦18.9000 ¦  1512.0 ¦  802.0 ¦ 604.0 ¦  4.5000 ¦
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)          dP(avg)   =   0.250

 Avg Orifice Meter Reading (in H2O)  dH(avg)   =   2.100

 Avg Stack Temperature (degF)        T(s avg)  =   168.0

 Average Meter Temperature (degF)    T(m avg)  =    78.1

 Avg SQRT(dP)                                  =   0.500

CALCULATED VALUES

 Meter Volume (std, cu. ft.)         V(m std)  =  147.06

 Stack Gas Water Vapor Proportion    B(wo)     =   0.406

 Mol. Wt., Stack Gas Dry             M(d)      =   29.97

 Mol. Wt., Stack Gas Wet             M(s)      =   25.11

 Abs Stack Pressure (in Hg)          P(s)      =   30.04

 Avg Stack Velocity (ft/sec)         V(s avg)  =    32.8

 Isokineticity (%)                   % I       =   106.9

 Stack Gas STD Vol Flow (dscfm)      Q(s)      =    1053

 Actual Stack Gas Vol Flow (acfm)    Q(a)      =    2101

Particulate Loading, dry(gr/dscf)    C(s std)  =  0.0000
Particulate Loading, @7% O2(mg/dscm)C(s std)  =       0
Particulate Loading, dry @ 7 % O2 (gr/dscf)   =  0.0000

Particulate Emission Rate(lb/hr)     E(p)      =   0.000
```

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********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF
Date:  01-21-88                      Performed by:       G.HILL
                                     Test No./Type:      S01211240M5
Sample Location: STACK               Start/Stop Time:    1240-1345

PARAMETER                             SYMBOL      VALUE
                                                  (calc.)
Nozzle Diameter, Actual (in)          N(d)         0.357
Pitot Tube Correction Factor          C(p)         0.8400
Gas Meter Correction Factor           (alpha)      0.9700
Stack (Duct) Dimensions (in):
        Radius (if round)             R              7.00
        Length (if rectangular)       L           --------
        Width (if rectangular)        W           --------
Area of Stack (sq ft)                 A(s)       (   1.07 )

# of Sample Points                    #                12
Total Sampling Time (min)             (theta)    (  60.00 )
Barometric Pressure (in Hg)           P(b)          30.05
Stack Pressure (in H2O)               P(stack)     -0.080
Gas Meter Initial Reading (cu ft)                  985.89
Gas Meter Final Reading (cu ft)                   1036.02
Net Gas Sample Volume (cu ft)         V(m)       (  50.13 )

Vol of Liquid Collected (ml)          Vl(c)         586.4
Vol of Liq @ Std. Conds. (scf)        V(w std)   ( 27.602 )
Wt. of Filter Particulate (gm)                     0.0100
Wt. of Probe Wash Particulate (gm)                 0.0000
Wt of Combined Particulate (gm)       M(p)       ( 0.0100 )

O2  Concentration (by CEM)            % O2          16.06
CO2 Concentration (by CEM)            % CO2          8.31
CO  Concentration (by CEM)            % CO            0.0
N2  Concentration (by diff.)          % N2       (  75.63 )
-------------------------------------------------------------------------------
Sample | dClock |Velocity|Orifice |  Stack   |    Gas  Meter     |SQRT(dP) |
Point  |  Time  |Head, dP|Meter,dH|  Temp    |   Temp  (degF)    |         |
       |        |(in H2O)|(in H2O)|  (degF)  |   in    |  out    |         |
-------+--------+--------+--------+----------+---------+---------+---------|
    E1 |      5 |   0.28 | 2.3800 |   170.0  |   56.0  |   47.0  |  0.5292 |
     2 |      5 |   0.28 | 2.3800 |   170.0  |   69.0  |   49.0  |  0.5292 |
     3 |      5 |   0.28 | 2.3800 |   170.0  |   80.0  |   52.0  |  0.5292 |
     4 |      5 |   0.25 | 2.1300 |   170.0  |   86.0  |   55.0  |  0.5000 |
     5 |      5 |   0.25 | 2.1300 |   170.0  |   90.0  |   59.0  |  0.5000 |
     6 |      5 |   0.25 | 2.1300 |   170.0  |   92.0  |   61.0  |  0.5000 |
     1 |      5 |   0.25 | 2.1300 |   170.0  |   86.0  |   55.0  |  0.5000 |
     2 |      5 |   0.26 | 2.2100 |   170.0  |   90.0  |   60.0  |  0.5099 |
     3 |      5 |   0.27 | 2.3000 |   170.0  |   95.0  |   66.0  |  0.5196 |
     4 |      5 |   0.26 | 2.2100 |   170.0  |   97.0  |   69.0  |  0.5099 |
     5 |      5 |   0.26 | 2.2100 |   170.0  |   98.0  |   70.0  |  0.5099 |
     6 |      5 |   0.27 | 2.3000 |   170.0  |   99.0  |   71.0  |  0.5196 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0  |    0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0  |    0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0  |    0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0  |    0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0  |    0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0  |    0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0  |    0.0  |  0.0000 |
-------+--------+--------+--------+----------+---------+---------+---------|
TOTALS |     60 |   3.16 |26.8900 |  2040.0  | 1038.0  |  714.0  |  6.1564 |

FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)               dP(avg)    =   0.263

 Avg Orifice Meter Reading (in H2O)       dH(avg)    =   2.241

 Avg Stack Temperature (degF)             T(s avg)   =   170.0

 Average Meter Temperature (degF)         T(m avg)   =    73.0

 Avg SQRT(dP)
                                                     =   0.513
CALCULATED VALUES

 Meter Volume (std, cu. ft.)              V(m std)   =   48.63

 Stack Gas Water Vapor Proportion         B(wo)      =   0.362

 Mol. Wt., Stack Gas Dry                  M(d)       =   29.97

 Mol. Wt., Stack Gas Wet                  M(s)       =   25.64

 Abs Stack Pressure (in Hg)               P(s)       =   30.04

 Avg Stack Velocity (ft/sec)              V(s avg)   =    33.3

 Isokineticity (%)                        % I        =   108.7

 Stack Gas STD Vol Flow (dscfm)           Q(s)       =    1147

 Actual Stack Gas Vol Flow (acfm)         Q(a)       =    2137

Particulate Loading, dry(gr/dscf)    C(s std) =  0.0032
Particulate Loading, @7% O2(mg/dscm)C(s std) =      21
Particulate Loading, dry @ 7 % O2 (gr/dscf)   =  0.0090

Particulate Emission Rate(lb/hr)     E(p)     =   0.031
```

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*********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                        Performed by:     C.KING
Date:  1-27-88                    Test No./Type:    E01271133MM5
Sample Location: E-DUCT           Start/Stop Time:  1133-1550

PARAMETER                          SYMBOL     VALUE
                                             (calc.)
Nozzle Diameter, Actual (in)       N(d)        0.375
Pitot Tube Correction Factor       C(p)       0.8400
Gas Meter Correction Factor        (alpha)    0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)          R            7.00
        Length (if rectangular)    L        --------
        Width (if rectangular)     W        --------
Area of Stack (sq ft)              A(s)     (   1.07 )

# of Sample Points                 #              13
Total Sampling Time (min)          (theta)  ( 233.00 )
Barometric Pressure (in Hg)        P(b)        30.00
Stack Pressure (in H2O)            P(stack)   -0.080
Gas Meter Initial Reading (cu ft)             768.51
Gas Meter Final Reading (cu ft)               952.37
Net Gas Sample Volume (cu ft)      V(m)     ( 183.85 )

Vol of Liquid Collected (ml)       Vl(c)      2103.3
Vol of Liq @ Std. Conds. (scf)     V(w std) ( 99.004 )
Wt. of Filter Particulate (gm)                0.0000
Wt. of Probe Wash Particulate (gm)            0.0000
Wt of Combined Particulate (gm)    M(p)     ( 0.0000 )

O2  Concentration (by CEM)         % O2        14.70
CO2 Concentration (by CEM)         % CO2        6.03
CO  Concentration (by CEM)         % CO          0.0
N2  Concentration (by diff.)       % N2     (  79.27 )

------------------------------------------------------------------------------
Sample : dClock :Velocity:Orifice :  Stack   :    Gas  Meter    :SQRT(dP) :
Point  :  Time  :Head, dP:Meter,dH:  Temp    :   Temp  (degF)   :         :
       :        :(in H20):(in H20): (degF)   :   in    :  out   :         :
-------+--------+--------+--------+----------+---------+--------+---------:
   T4  :     25 :   0.20 : 1.6800 :   168.0  :   63.0  :  57.0  :  0.4472 :
    3  :     25 :   0.25 : 2.1000 :   168.0  :  103.0  :  68.0  :  0.5000 :
    2  :     25 :   0.25 : 2.1000 :   168.0  :  110.0  :  80.0  :  0.5000 :
    1  :      8 :   0.25 : 2.1000 :   168.0  :  110.0  :  80.0  :  0.5000 :
    1  :     17 :   0.25 : 2.1000 :   168.0  :  110.0  :  80.0  :  0.5000 :
  RS4  :     12 :   0.25 : 2.1000 :   168.0  :   90.0  :  80.0  :  0.5000 :
    4  :     13 :   0.19 : 1.6000 :   168.0  :   90.0  :  80.0  :  0.4359 :
    4  :     12 :   0.20 : 1.6800 :   168.0  :   90.0  :  80.0  :  0.4472 :
    3  :     25 :   0.20 : 1.6800 :   168.0  :   90.0  :  80.0  :  0.4472 :
    2  :     25 :   0.20 : 1.6800 :   168.0  :   90.0  :  80.0  :  0.4472 :
    1  :      5 :   0.20 : 1.6800 :   168.0  :   90.0  :  80.0  :  0.4472 :
    1  :     20 :   0.20 : 1.6800 :   168.0  :   90.0  :  80.0  :  0.4472 :
    4  :     21 :   0.20 : 1.6800 :   168.0  :   90.0  :  80.0  :  0.4472 :
    0  :      0 :   0.00 : 0.0000 :     0.0  :    0.0  :   0.0  :  0.0000 :
    0  :      0 :   0.00 : 0.0000 :     0.0  :    0.0  :   0.0  :  0.0000 :
    0  :      0 :   0.00 : 0.0000 :     0.0  :    0.0  :   0.0  :  0.0000 :
    0  :      0 :   0.00 : 0.0000 :     0.0  :    0.0  :   0.0  :  0.0000 :
    0  :      0 :   0.00 : 0.0000 :     0.0  :    0.0  :   0.0  :  0.0000 :
    0  :      0 :   0.00 : 0.0000 :     0.0  :    0.0  :   0.0  :  0.0000 :
-------+--------+--------+--------+----------+---------+--------+---------:
TOTALS :    233 :   2.84 :23.8600 :  2184.0  : 1216.0  : 1005.0 :  6.0664 :
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H20)              dP(avg)   =   0.218

 Avg Orifice Meter Reading (in H20)      dH(avg)   =   1.835

 Avg Stack Temperature (degF)            T(s avg)  =   168.0

 Average Meter Temperature (degF)        T(m avg)  =    85.4

 Avg SQRT(dP)                                      =   0.467

CALCULATED VALUES

 Meter Volume (std, cu. ft.)             V(m std)  =  177.39

 Stack Gas Water Vapor Proportion        B(wo)     =   0.358

 Mol. Wt., Stack Gas Dry                 M(d)      =   29.55

 Mol. Wt., Stack Gas Wet                 M(s)      =   25.41

 Abs Stack Pressure (in Hg)              P(s)      =   29.99

 Avg Stack Velocity (ft/sec)             V(s avg)  =    30.4

 Isokineticity (%)                       % I       =   100.6

 Stack Gas STD Vol Flow (dscfm)          Q(s)      =    1055

 Actual Stack Gas Vol Flow (acfm)        Q(a)      =    1951

 Particulate Loading, dry(gr/dscf)    C(s std) =  0.0000
 Particulate Loading, @7% O2(mg/dscm)C(s std) =       0
 Particulate Loading, dry @ 7 % O2 (gr/dscf)  =  0.0000

 Particulate Emission Rate(lb/hr)        E(p)      =   0.000
```

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**********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS        FIELD DATA AVERAGES
Plant: CRF                         Performed by:      G.HILL
Date:  1-27-88                     Test No./Type:     S01271135MM5    Avg Velocity Head (in H2O)          dP(avg)   =    0.167
Sample Location: STACK             Start/Stop Time:   1135-1608
                                                                      Avg Orifice Meter Reading (in H2O)  dH(avg)   =    1.335
PARAMETER                           SYMBOL     VALUE
                                               (calc.)                Avg Stack Temperature (degF)        T(s avg)  =    170.0
Nozzle Diameter, Actual (in)       N(d)        0.375
Pitot Tube Correction Factor       C(p)        0.8400                 Average Meter Temperature (degF)    T(m avg)  =     84.0
Gas Meter Correction Factor        (alpha)     1.0000
Stack (Duct) Dimensions (in):                                         Avg SQRT(dP)                                  =    0.408
        Radius (if round)          R             7.00
        Length (if rectangular)    L          --------                CALCULATED VALUES
        Width (if rectangular)     W          --------
Area of Stack (sq ft)              A(s)      (   1.07 )               Meter Volume (std, cu. ft.)         V(m std)  =   165.96

# of Sample Points                 #               13                 Stack Gas Water Vapor Proportion    B(wo)     =    0.408
Total Sampling Time (min)          (theta)   ( 261.00 )
Barometric Pressure (in Hg)        P(b)         30.00                 Mol. Wt., Stack Gas Dry             M(d)      =    29.55
Stack Pressure (in H2O)            P(stack)    -0.080
Gas Meter Initial Reading (cu ft)              608.49                 Mol. Wt., Stack Gas Wet             M(s)      =    24.84
Gas Meter Final Reading (cu ft)                778.51
Net Gas Sample Volume (cu ft)      V(m)      ( 170.03 )               Abs Stack Pressure (in Hg)          P(s)      =    29.99

Vol of Liquid Collected (ml)       Vl(c)       2428.4                 Avg Stack Velocity (ft/sec)         V(s avg)  =     27.0
Vol of Liq @ Std. Conds. (scf)     V(w std)  (114.306 )
Wt. of Filter Particulate (gm)                 0.0000                 Isokineticity (%)                   % I       =    103.1
Wt. of Probe Wash Particulate (gm)             0.0000
Wt of Combined Particulate (gm)    M(p)      ( 0.0000 )               Stack Gas STD Vol Flow (dscfm)      Q(s)      =      860

O2  Concentration (by CEM)         % O2         14.70                 Actual Stack Gas Vol Flow (acfm)    Q(a)      =     1729
CO2 Concentration (by CEM)         % CO2         6.03
CO  Concentration (by CEM)         % CO          0.0                  Particulate Loading, dry(gr/dscf)   C(s std)  =   0.0000
N2  Concentration (by diff.)       % N2      (  79.27 )               Particulate Loading, @7% O2(mg/dscm)C(s std)  =        0
--------------------------------------------------------------------- Particulate Loading, dry @ 7 % O2 (gr/dscf)   =   0.0000
Sample ! dClock  !Velocity!Orifice !  Stack   !    Gas  Meter   !SQRT(dP) !
Point  !  Time   !Head, dP!Meter,dH!  Temp    !   Temp  (degF)  !         !Particulate Emission Rate(lb/hr)    E(p)      =    0.000
       !         !(in H2O)!(in H2O)! (degF)   !    in  !  out   !         !
-------+---------+--------+--------+----------+--------+--------+---------!
    S1 !      20 !   0.15 ! 1.2000 !    170.0 !   53.0 !   53.0 !  0.3873 !
     2 !      20 !   0.15 ! 1.2000 !    170.0 !   80.0 !   60.0 !  0.3873 !
     3 !      20 !   0.17 ! 1.3600 !    170.0 !   93.0 !   72.0 !  0.4123 !
     4 !      20 !   0.19 ! 1.5200 !    170.0 !   97.0 !   76.0 !  0.4359 !
     5 !      20 !   0.19 ! 1.5200 !    170.0 !   82.0 !   81.0 !  0.4359 !
     6 !      20 !   0.17 ! 1.3600 !    170.0 !   98.0 !   81.0 !  0.4123 !
    N1 !      20 !   0.17 ! 1.3600 !    170.0 !   89.0 !   81.0 !  0.4123 !
     2 !      20 !   0.17 ! 1.3600 !    170.0 !   98.0 !   81.0 !  0.4123 !
     3 !      20 !   0.17 ! 1.3600 !    170.0 !   99.0 !   81.0 !  0.4123 !
     4 !      20 !   0.17 ! 1.3600 !    170.0 !  101.0 !   82.0 !  0.4123 !
     5 !       3 !   0.17 ! 1.3600 !    170.0 !   99.0 !   83.0 !  0.4123 !
     5 !      20 !   0.15 ! 1.2000 !    170.0 !   99.0 !   83.0 !  0.3873 !
     6 !      38 !   0.15 ! 1.2000 !    170.0 !   98.0 !   83.0 !  0.3873 !
     0 !       0 !   0.00 ! 0.0000 !      0.0 !    0.0 !    0.0 !  0.0000 !
     0 !       0 !   0.00 ! 0.0000 !      0.0 !    0.0 !    0.0 !  0.0000 !
     0 !       0 !   0.00 ! 0.0000 !      0.0 !    0.0 !    0.0 !  0.0000 !
     0 !       0 !   0.00 ! 0.0000 !      0.0 !    0.0 !    0.0 !  0.0000 !
     0 !       0 !   0.00 ! 0.0000 !      0.0 !    0.0 !    0.0 !  0.0000 !
     0 !       0 !   0.00 ! 0.0000 !      0.0 !    0.0 !    0.0 !  0.0000 !
-------+---------+--------+--------+----------+--------+--------+---------!
TOTALS !     261 !   2.17 !17.3600 !   2210.0 ! 1186.0 !  997.0 !  5.3071 !
```

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********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                            Performed by:      C. KING
Date:  1-27-88                        Test No./Type:     E01271139M5
Sample Location: E-DUCT               Start/Stop Time:   1139-1247

PARAMETER                              SYMBOL     VALUE
                                                  (calc.)
Nozzle Diameter, Actual (in)           N(d)        0.375
Pitot Tube Correction Factor           C(p)       0.8400
Gas Meter Correction Factor            (alpha)    0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)              R            7.00
        Length (if rectangular)        L        --------
        Width (if rectangular)         W        --------
Area of Stack (sq ft)                  A(s)     (   1.07 )

# of Sample Points                     #              16
Total Sampling Time (min)              (theta)  (  64.00 )
Barometric Pressure (in Hg)            P(b)        30.00
Stack Pressure (in H2O)                P(stack)   -0.080
Gas Meter Initial Reading (cu ft)                  86.11
Gas Meter Final Reading (cu ft)                   130.78
Net Gas Sample Volume (cu ft)          V(m)     (  44.67 )

Vol of Liquid Collected (ml)           Vl(c)       531.9
Vol of Liq @ Std. Conds. (scf)         V(w std) ( 25.038 )
Wt. of Filter Particulate (gm)                    0.0150
Wt. of Probe Wash Particulate (gm)                0.0000
Wt of Combined Particulate (gm)        M(p)     ( 0.0150 )

O2  Concentration (by CEM)             % O2        14.70
CO2 Concentration (by CEM)             % CO2        6.03
CO  Concentration (by CEM)             % CO          0.0
N2  Concentration (by diff.)           % N2     (  79.27 )
-----------------------------------------------------------------------------
Sample : dClock :Velocity:Orifice :  Stack  :     Gas  Meter    :SQRT(dP) :
Point  :  Time  :Head, dP:Meter,dH:  Temp   :    Temp  (degF)   :         :
       :        :(in H2O):(in H2O): (degF)  :     in   :  out   :         :
-------+--------+--------+--------+---------+--------+---------+----------:
    E1 :      4 :   0.20 : 1.6800 :   168.0 :   63.0 :    57.0 :  0.4472 :
     2 :      4 :   0.20 : 1.6800 :   168.0 :   79.0 :    58.0 :  0.4472 :
     3 :      4 :   0.20 : 1.6800 :   168.0 :   81.0 :    58.0 :  0.4472 :
     4 :      4 :   0.20 : 1.6800 :   168.0 :   82.0 :    59.0 :  0.4472 :
     5 :      4 :   0.20 : 1.6800 :   168.0 :   85.0 :    61.0 :  0.4472 :
     6 :      4 :   0.20 : 1.6800 :   168.0 :   89.0 :    65.0 :  0.4472 :
     7 :      4 :   0.20 : 1.6800 :   168.0 :   90.0 :    65.0 :  0.4472 :
     8 :      4 :   0.20 : 1.6800 :   168.0 :   90.0 :    65.0 :  0.4472 :
     1 :      4 :   0.20 : 1.6800 :   168.0 :   90.0 :    65.0 :  0.4472 :
     2 :      4 :   0.20 : 1.6800 :   168.0 :   96.0 :    81.0 :  0.4472 :
     3 :      4 :   0.20 : 1.6800 :   168.0 :  101.0 :    83.0 :  0.4472 :
     4 :      4 :   0.20 : 1.6800 :   168.0 :  101.0 :    83.0 :  0.4472 :
     5 :      4 :   0.20 : 1.6800 :   168.0 :  101.0 :    83.0 :  0.4472 :
     6 :      4 :   0.20 : 1.6800 :   168.0 :  101.0 :    83.0 :  0.4472 :
     7 :      4 :   0.20 : 1.6800 :   168.0 :  101.0 :    83.0 :  0.4472 :
     8 :      4 :   0.20 : 1.6800 :   168.0 :  101.0 :    83.0 :  0.4472 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :     0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :     0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :    0.0 :     0.0 :  0.0000 :
-------+--------+--------+--------+---------+--------+---------+----------:
TOTALS :     64 :   3.20 :26.8800 :  2688.0 : 1451.0 :  1132.0 :  7.1554 :
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)           dP(avg)  =   0.200

 Avg Orifice Meter Reading (in H2O)   dH(avg)  =   1.680

 Avg Stack Temperature (degF)         T(s avg) =   168.0

 Average Meter Temperature (degF)     T(m avg) =    80.7

 Avg SQRT(dP)                                  =   0.447

CALCULATED VALUES

 Meter Volume (std, cu. ft.)          V(m std) =   43.46

 Stack Gas Water Vapor Proportion     B(wo)    =   0.366

 Mol. Wt., Stack Gas Dry              M(d)     =   29.55

 Mol. Wt., Stack Gas Wet              M(s)     =   25.33

 Abs Stack Pressure (in Hg)           P(s)     =   29.99

 Avg Stack Velocity (ft/sec)          V(s avg) =    29.2

 Isokineticity (%)                    % I      =    94.6

 Stack Gas STD Vol Flow (dscfm)       Q(s)     =    1002

 Actual Stack Gas Vol Flow (acfm)     Q(a)     =    1873

 Particulate Loading, dry(gr/dscf)    C(s std) =  0.0053
 Particulate Loading, @7% O2(mg/dscm)C(s std)  =      27
 Particulate Loading, dry @ 7 % O2 (gr/dscf)   =  0.0118

 Particulate Emission Rate(lb/hr)     E(p)     =   0.046
```

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********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                              Performed by:      G.HILL
Date:  1-27-88                          Test No./Type:     S01271145MS
Sample Location: STACK                  Start/Stop Time:   1145-1250

PARAMETER                               SYMBOL     VALUE
                                                   (calc.)
Nozzle Diameter, Actual (in)            N(d)         0.375
Pitot Tube Correction Factor            C(p)        0.8400
Gas Meter Correction Factor             (alpha)     0.9700
Stack (Duct) Dimensions (in):
        Radius (if round)               R             7.00
        Length (if rectangular)         L         --------
        Width (if rectangular)          W         --------
Area of Stack (sq ft)                   A(s)      (   1.07 )

# of Sample Points                      #               12
Total Sampling Time (min)               (theta)   (  60.00 )
Barometric Pressure (in Hg)             P(b)         30.00
Stack Pressure (in H2O)                 P(stack)    -0.080
Gas Meter Initial Reading (cu ft)                   122.02
Gas Meter Final Reading (cu ft)                     163.69
Net Gas Sample Volume (cu ft)           V(m)      (  41.67 )

Vol of Liquid Collected (ml)            Vl(c)        398.6
Vol of Liq @ Std. Conds. (scf)          V(w std)  ( 18.764 )
Wt. of Filter Particulate (gm)                      0.0088
Wt. of Probe Wash Particulate (gm)                  0.0100
Wt of Combined Particulate (gm)         M(p)      ( 0.0188 )

O2  Concentration (by CEM)              % O2         14.70
CO2 Concentration (by CEM)              % CO2         6.03
CO  Concentration (by CEM)              % CO           0.0
N2  Concentration (by diff.)            % N2      (  79.27 )
-------------------------------------------------------------------------------
Sample ¦ dClock ¦Velocity¦Orifice ¦  Stack   ¦    Gas   Meter     ¦SQRT(dP) ¦
Point  ¦  Time  ¦Head, dP¦Meter,dH¦  Temp    ¦   Temp   (degF)    ¦         ¦
       ¦        ¦(in H2O)¦(in H2O)¦ (degF)   ¦    in   ¦  out     ¦         ¦
-------+--------+--------+--------+----------+---------+----------+---------¦
    E1 ¦      5 ¦   0.15 ¦ 1.3000 ¦    170.0 ¦    55.0 ¦     54.0 ¦  0.3873 ¦
     2 ¦      5 ¦   0.15 ¦ 1.3000 ¦    170.0 ¦    73.0 ¦     54.0 ¦  0.3873 ¦
     3 ¦      5 ¦   0.15 ¦ 1.3000 ¦    170.0 ¦    82.0 ¦     56.0 ¦  0.3873 ¦
     4 ¦      5 ¦   0.17 ¦ 1.4500 ¦    170.0 ¦    88.0 ¦     59.0 ¦  0.4123 ¦
     5 ¦      5 ¦   0.17 ¦ 1.4500 ¦    170.0 ¦    97.0 ¦     63.0 ¦  0.4123 ¦
     6 ¦      5 ¦   0.17 ¦ 1.4500 ¦    170.0 ¦   100.0 ¦     69.0 ¦  0.4123 ¦
     1 ¦      5 ¦   0.17 ¦ 1.4500 ¦    170.0 ¦    88.0 ¦     63.0 ¦  0.4123 ¦
     2 ¦      5 ¦   0.15 ¦ 1.3000 ¦    170.0 ¦   106.0 ¦     81.0 ¦  0.3873 ¦
     3 ¦      5 ¦   0.15 ¦ 1.3000 ¦    170.0 ¦   105.0 ¦     83.0 ¦  0.3873 ¦
     4 ¦      5 ¦   0.16 ¦ 1.3600 ¦    170.0 ¦   106.0 ¦     85.0 ¦  0.4000 ¦
     5 ¦      5 ¦   0.17 ¦ 1.4500 ¦    170.0 ¦   109.0 ¦     88.0 ¦  0.4123 ¦
     6 ¦      5 ¦   0.17 ¦ 1.4500 ¦    170.0 ¦   109.0 ¦     88.0 ¦  0.4123 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦      0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦      0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦      0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦      0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦      0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦      0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦      0.0 ¦     0.0 ¦      0.0 ¦  0.0000 ¦
-------+--------+--------+--------+----------+---------+----------+---------¦
TOTALS ¦     60 ¦   1.93 ¦16.5600 ¦   2040.0 ¦  1118.0 ¦    843.0 ¦  4.8104 ¦
```

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FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)             dP(avg)   =    0.161

 Avg Orifice Meter Reading (in H2O)     dH(avg)   =    1.380

 Avg Stack Temperature (degF)           T(s avg)  =    170.0

 Average Meter Temperature (degF)       T(m avg)  =     81.7

 Avg SQRT(dP)                                     =    0.401

CALCULATED VALUES

 Meter Volume (std, cu. ft.)            V(m std)  =    39.62

 Stack Gas Water Vapor Proportion       B(wo)     =    0.321

 Mol. Wt., Stack Gas Dry                M(d)      =    29.55

 Mol. Wt., Stack Gas Wet                M(s)      =    25.84

 Abs Stack Pressure (in Hg)             P(s)      =    29.99

 Avg Stack Velocity (ft/sec)            V(s avg)  =     26.0

 Isokineticity (%)                      % I       =     97.0

 Stack Gas STD Vol Flow (dscfm)         Q(s)      =      949

 Actual Stack Gas Vol Flow (acfm)       Q(a)      =     1665

Particulate Loading, dry(gr/dscf)   C(s std) =  0.0073
Particulate Loading, @7% O2(mg/dscm)C(s std) =      37
Particulate Loading, dry @ 7 % O2 (gr/dscf)  =  0.0163

¦Particulate Emission Rate(lb/hr)    E(p)     =   0.060
```

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********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                            Performed by:      C.KING
Date:  1-29-88                        Test No./Type:     E01291153MM5
Sample Location: E-DUCT               Start/Stop Time:   1153-1447

PARAMETER                              SYMBOL     VALUE
                                                  (calc.)
Nozzle Diameter, Actual (in)           N(d)        0.375
Pitot Tube Correction Factor           C(p)        0.8400
Gas Meter Correction Factor            (alpha)     0.9900
Stack (Duct) Dimensions (in):
        Radius (if round)              R            7.00
        Length (if rectangular)        L          --------
        Width (if rectangular)         W          --------
Area of Stack (sq ft)                  A(s)      (   1.07 )

# of Sample Points                     #               7
Total Sampling Time (min)              (theta)   ( 167.00 )
Barometric Pressure (in Hg)            P(b)        30.00
Stack Pressure (in H2O)                P(stack)   -0.080
Gas Meter Initial Reading (cu ft)                 963.80
Gas Meter Final Reading (cu ft)                  1133.96
Net Gas Sample Volume (cu ft)          V(m)      ( 170.16 )

Vol of Liquid Collected (ml)           Vl(c)      1550.5
Vol of Liq @ Std. Conds. (scf)         V(w std)  ( 72.983 )
Wt. of Filter Particulate (gm)                    0.0000
Wt. of Probe Wash Particulate (gm)                0.0000
Wt of Combined Particulate (gm)        M(p)      ( 0.0000 )

O2  Concentration (by CEM)             % O2        13.91
CO2 Concentration (by CEM)             % CO2        4.79
CO  Concentration (by CEM)             % CO         0.0
N2  Concentration (by diff.)           % N2      (  81.30 )
------------------------------------------------------------------------------
Sample | dClock |Velocity|Orifice |  Stack   |    Gas  Meter     |SQRT(dP) |
Point  |  Time  |Head, dP|Meter,dH|  Temp    |   Temp  (degF)    |         |
       |        |(in H2O)|(in H2O)| (degF)   |    in  |  out     |         |
-------+--------+--------+--------+----------+--------+----------+---------|
    T4 |     25 |   0.35 | 2.9000 |   169.0  |   70.0 |    64.0  |  0.5916 |
     3 |     25 |   0.31 | 2.6000 |   169.0  |  110.0 |    90.0  |  0.5568 |
     2 |     25 |   0.28 | 2.4000 |   169.0  |  110.0 |    90.0  |  0.5292 |
     1 |     25 |   0.31 | 2.6000 |   169.0  |  110.0 |    90.0  |  0.5568 |
   RS1 |     25 |   0.27 | 2.3000 |   169.0  |  115.0 |    98.0  |  0.5196 |
     2 |     25 |   0.35 | 2.9000 |   169.0  |  115.0 |    98.0  |  0.5916 |
     3 |     17 |   0.27 | 2.3000 |   169.0  |  115.0 |    98.0  |  0.5196 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0 |     0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0 |     0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0 |     0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0 |     0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0 |     0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0 |     0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0 |     0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0 |     0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0 |     0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0 |     0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0 |     0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0 |     0.0  |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |     0.0  |    0.0 |     0.0  |  0.0000 |
-------+--------+--------+--------+----------+--------+----------+---------|
TOTALS |    167 |   2.14 |18.0000 |  1183.0  |  745.0 |   628.0  |  3.8651 |
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)             dP(avg)   =    0.306

 Avg Orifice Meter Reading (in H2O)     dH(avg)   =    2.571

 Avg Stack Temperature (degF)           T(s avg)  =    169.0

 Average Meter Temperature (degF)       T(m avg)  =     98.1

 Avg SQRT(dP)                                     =    0.552

CALCULATED VALUES

 Meter Volume (std, cu. ft.)            V(m std)  =   160.75

 Stack Gas Water Vapor Proportion       B(wo)     =    0.312

 Mol. Wt., Stack Gas Dry                M(d)      =    29.32

 Mol. Wt., Stack Gas Wet                M(s)      =    25.79

 Abs Stack Pressure (in Hg)             P(s)      =    29.99

 Avg Stack Velocity (ft/sec)            V(s avg)  =     35.8

 Isokineticity (%)                      % I       =    101.2

 Stack Gas STD Vol Flow (dscfm)         Q(s)      =     1327

 Actual Stack Gas Vol Flow (acfm)       Q(a)      =     2294

Particulate Loading, dry(gr/dscf)    C(s std) =   0.0000
Particulate Loading, @7% O2(mg/dscm)C(s std) =        0
Particulate Loading, dry @ 7 % O2 (gr/dscf)  =   0.0000

Particulate Emission Rate(lb/hr)     E(p)     =    0.000
```

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*********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                          Performed by:     G.HILL
Date:  1-29-88                      Test No./Type:    S01291155MM5
Sample Location: STACK              Start/Stop Time:  1155-1500

PARAMETER                            SYMBOL     VALUE
                                               (calc.)
Nozzle Diameter, Actual (in)        N(d)        0.357
Pitot Tube Correction Factor        C(p)        0.8400
Gas Meter Correction Factor         (alpha)     1.0000
Stack (Duct) Dimensions (in):
        Radius (if round)           R            7.00
        Length (if rectangular)     L          --------
        Width (if rectangular)      W          --------
Area of Stack (sq ft)               A(s)      (   1.07 )

# of Sample Points                  #               9
Total Sampling Time (min)           (theta)   ( 180.00 )
Barometric Pressure (in Hg)         P(b)        30.00
Stack Pressure (in H2O)             P(stack)    -0.080
Gas Meter Initial Reading (cu ft)               800.88
Gas Meter Final Reading (cu ft)                 970.90
Net Gas Sample Volume (cu ft)       V(m)      ( 170.02 )

Vol of Liquid Collected (ml)        Vl(c)       1721.3
Vol of Liq @ Std. Conds. (scf)      V(w std)  ( 81.023 )
Wt. of Filter Particulate (gm)                  0.0000
Wt. of Probe Wash Particulate (gm)              0.0000
Wt of Combined Particulate (gm)     M(p)      ( 0.0000 )

O2  Concentration (by CEM)          % O2         13.91
CO2 Concentration (by CEM)          % CO2         4.79
CO  Concentration (by CEM)          % CO          0.0
N2  Concentration (by diff.)        % N2      (  81.30 )
-----------------------------------------------------------------------------
Sample : dClock :Velocity:Orifice :  Stack  :    Gas  Meter   :SQRT(dP) :
Point  :  Time  :Head, dP:Meter,dH:  Temp   :    Temp  (degF) :         :
       :        :(in H2O):(in H2O): (degF)  :    in   :  out  :         :
-------+--------+--------+--------+---------+---------+-------+---------:
    S1 :     20 :   0.33 : 2.6400 :   170.0 :    81.0 :  67.0 :  0.5745 :
     2 :     20 :   0.35 : 2.8000 :   170.0 :   105.0 :  75.0 :  0.5916 :
     3 :     20 :   0.35 : 2.8000 :   170.0 :   110.0 :  81.0 :  0.5916 :
     4 :     20 :   0.34 : 2.7200 :   170.0 :   111.0 :  85.0 :  0.5831 :
     5 :     20 :   0.35 : 2.8000 :   170.0 :   116.0 :  89.0 :  0.5916 :
     6 :     20 :   0.35 : 2.8000 :   170.0 :   116.0 :  90.0 :  0.5916 :
    N1 :     20 :   0.34 : 2.7200 :   170.0 :    85.0 :  80.0 :  0.5831 :
     2 :     20 :   0.31 : 2.4800 :   170.0 :   113.0 :  91.0 :  0.5568 :
     3 :     20 :   0.31 : 2.4800 :   170.0 :   112.0 :  91.0 :  0.5568 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :   0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :   0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :   0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :   0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :   0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :   0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :   0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :   0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :   0.0 :  0.0000 :
     0 :      0 :   0.00 : 0.0000 :     0.0 :     0.0 :   0.0 :  0.0000 :
-------+--------+--------+--------+---------+---------+-------+---------:
TOTALS :    180 :   3.03 :24.2400 :  1530.0 :   949.0 : 749.0 :  5.2206 :
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)              dP(avg)   =   0.337

 Avg Orifice Meter Reading (in H2O)  dH(avg)   =   2.693

 Avg Stack Temperature (degF)          T(s avg) =   170.0

 Average Meter Temperature (degF)      T(m avg) =    94.3

 Avg SQRT(dP)                                     =   0.580

CALCULATED VALUES

 Meter Volume (std, cu. ft.)           V(m std) =  163.38

 Stack Gas Water Vapor Proportion      B(wo)    =   0.332

 Mol. Wt., Stack Gas Dry               M(d)     =   29.32

 Mol. Wt., Stack Gas Wet               M(s)     =   25.57

 Abs Stack Pressure (in Hg)            P(s)     =   29.99

 Avg Stack Velocity (ft/sec)           V(s avg) =    37.8

 Isokineticity (%)                     % I      =   102.7

 Stack Gas STD Vol Flow (dscfm)        Q(s)     =    1360

 Actual Stack Gas Vol Flow (acfm)      Q(a)     =    2422

 Particulate Loading, dry(gr/dscf)     C(s std) =  0.0000
 Particulate Loading, @7% O2(mg/dscm)C(s std) =       0
 Particulate Loading, dry @ 7 % O2 (gr/dscf)   =  0.0000

:Particulate Emission Rate(lb/hr)      E(p)     =   0.000
```

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********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS          FIELD DATA AVERAGES
Plant: CRF                             Performed by:     C. KING
Date:  1-29-88                         Test No./Type:    E01291305M5     Avg Velocity Head (in H2O)          dP(avg)  =   0.310
Sample Location: E-DUCT                Start/Stop Time:  1305-1409
                                                                         Avg Orifice Meter Reading (in H2O)  dH(avg)  =   2.600
PARAMETER                               SYMBOL    VALUE
                                                  (calc.)                Avg Stack Temperature (degF)        T(s avg) =   169.0
Nozzle Diameter, Actual (in)           N(d)        0.357
Pitot Tube Correction Factor           C(p)        0.8400                Average Meter Temperature (degF)    T(m avg) =   105.3
Gas Meter Correction Factor            (alpha)     0.9900
Stack (Duct) Dimensions (in):                                            Avg SQRT(dP)                                 =   0.557
        Radius (if round)              R           7.00
        Length (if rectangular)        L          --------              CALCULATED VALUES
        Width (if rectangular)         W          --------
Area of Stack (sq ft)                  A(s)     (   1.07 )               Meter Volume (std, cu. ft.)         V(m std) =   51.49

# of Sample Points                     #             16                  Stack Gas Water Vapor Proportion    B(wo)    =   0.349
Total Sampling Time (min)              (theta)  (  64.00 )
Barometric Pressure (in Hg)            P(b)        30.00                 Mol. Wt., Stack Gas Dry             M(d)     =   29.32
Stack Pressure (in H2O)                P(stack)   -0.080
Gas Meter Initial Reading (cu ft)                  159.01                Mol. Wt., Stack Gas Wet             M(s)     =   25.38
Gas Meter Final Reading (cu ft)                    214.22
Net Gas Sample Volume (cu ft)          V(m)     (  55.21 )               Abs Stack Pressure (in Hg)          P(s)     =   29.99

Vol of Liquid Collected (ml)           Vl(c)       585.4                 Avg Stack Velocity (ft/sec)         V(s avg) =    36.3
Vol of Liq @ Std. Conds. (scf)         V(w std) ( 27.556 )
Wt. of Filter Particulate (gm)                     0.0177                Isokineticity (%)                   % I      =    96.9
Wt. of Probe Wash Particulate (gm)                 0.0100
Wt of Combined Particulate (gm)        M(p)     ( 0.0277 )               Stack Gas STD Vol Flow (dscfm)      Q(s)     =    1278

O2  Concentration (by CEM)             % O2        13.91                 Actual Stack Gas Vol Flow (acfm)    Q(a)     =    2331
CO2 Concentration (by CEM)             % CO2        4.79
CO  Concentration (by CEM)             % CO         0.0                  Particulate Loading, dry(gr/dscf)   C(s std) =  0.0083
N2  Concentration (by diff.)           % N2     (  81.30 )               Particulate Loading, @7% O2(mg/dscm)C(s std) =      38
--------------------------------------------------------------------------Particulate Loading, dry @ 7 % O2 (gr/dscf)  =  0.0164
Sample | dClock |Velocity|Orifice |  Stack   |    Gas  Meter    |SQRT(dP) |
Point  |  Time  |Head, dP|Meter,dH|  Temp    |   Temp  (degF)   |         |Particulate Emission Rate(lb/hr)    E(p)     =   0.091
       |        |(in H2O)|(in H2O)| (degF)   |    in   |  out   |         |
-------+--------+--------+--------+----------+---------+--------+---------|
    E1 |      4 |   0.31 | 2.6000 |    169.0 |    80.0 |   73.0 |  0.5568 |
     2 |      4 |   0.31 | 2.6000 |    169.0 |    90.0 |   80.0 |  0.5568 |
     3 |      4 |   0.31 | 2.6000 |    169.0 |   100.0 |   92.0 |  0.5568 |
     4 |      4 |   0.31 | 2.6000 |    169.0 |   110.0 |   94.0 |  0.5568 |
     5 |      4 |   0.31 | 2.6000 |    169.0 |   120.0 |  101.0 |  0.5568 |
     6 |      4 |   0.31 | 2.6000 |    169.0 |   120.0 |  101.0 |  0.5568 |
     7 |      4 |   0.31 | 2.6000 |    169.0 |   120.0 |  101.0 |  0.5568 |
     8 |      4 |   0.31 | 2.6000 |    169.0 |   120.0 |  101.0 |  0.5568 |
     1 |      4 |   0.31 | 2.6000 |    169.0 |   120.0 |  101.0 |  0.5568 |
     2 |      4 |   0.31 | 2.6000 |    169.0 |   120.0 |  101.0 |  0.5568 |
     3 |      4 |   0.31 | 2.6000 |    169.0 |   120.0 |  101.0 |  0.5568 |
     4 |      4 |   0.31 | 2.6000 |    169.0 |   120.0 |  101.0 |  0.5568 |
     5 |      4 |   0.31 | 2.6000 |    169.0 |   120.0 |  101.0 |  0.5568 |
     6 |      4 |   0.31 | 2.6000 |    169.0 |   120.0 |  101.0 |  0.5568 |
     7 |      4 |   0.31 | 2.6000 |    169.0 |   120.0 |  101.0 |  0.5568 |
     8 |      4 |   0.31 | 2.6000 |    169.0 |   120.0 |  101.0 |  0.5568 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |     0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |     0.0 |    0.0 |  0.0000 |
     0 |      0 |   0.00 | 0.0000 |      0.0 |     0.0 |    0.0 |  0.0000 |
-------+--------+--------+--------+----------+---------+--------+---------|
TOTALS |     64 |   4.96 |41.6000 |   2704.0 |  1820.0 | 1551.0 |  8.9084 |
********************************
ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS
Plant: CRF                                Performed by:     G.HILL
Date:  1-29-88                            Test No./Type:    S01291236M5
Sample Location: STACK                    Start/Stop Time:  1236-1340

PARAMETER                                  SYMBOL    VALUE
                                                     (calc.)
Nozzle Diameter, Actual (in)              N(d)        0.357
Pitot Tube Correction Factor              C(p)        0.8400
Gas Meter Correction Factor               (alpha)     0.9700
Stack (Duct) Dimensions (in):
        Radius (if round)                 R             7.00
        Length (if rectangular)           L         --------
        Width (if rectangular)            W         --------
Area of Stack (sq ft)                     A(s)      (   1.07 )

# of Sample Points                        #               12
Total Sampling Time (min)                 (theta)   (  60.00 )
Barometric Pressure (in Hg)               P(b)         30.00
Stack Pressure (in H2O)                   P(stack)    -0.080
Gas Meter Initial Reading (cu ft)                     178.87
Gas Meter Final Reading (cu ft)                       240.67
Net Gas Sample Volume (cu ft)             V(m)      (  61.81 )

Vol of Liquid Collected (ml)              Vl(c)        457.3
Vol of Liq @ Std. Conds. (scf)            V(w std)  ( 21.525 )
Wt. of Filter Particulate (gm)                        0.0121
Wt. of Probe Wash Particulate (gm)                    0.0200
Wt of Combined Particulate (gm)           M(p)      ( 0.0321 )

O2  Concentration (by CEM)                % O2         13.91
CO2 Concentration (by CEM)                % CO2         4.79
CO  Concentration (by CEM)                % CO           0.0
N2  Concentration (by diff.)              % N2      (  81.30 )
-----------------------------------------------------------------------
Sample ¦ dClock ¦Velocity¦Orifice ¦  Stack   ¦   Gas  Meter    ¦SQRT(dP) ¦
Point  ¦  Time  ¦Head, dP¦Meter,dH¦  Temp    ¦   Temp  (degF)  ¦         ¦
       ¦        ¦(in H2O)¦(in H2O)¦ (degF)   ¦   in    ¦  out  ¦         ¦
-------+--------+--------+--------+----------+---------+-------+---------¦
    E1 ¦      5 ¦   0.33 ¦ 2.8100 ¦   170.0 ¦    72.0 ¦   65.0 ¦  0.5745 ¦
     2 ¦      5 ¦   0.33 ¦ 2.8100 ¦   170.0 ¦    88.0 ¦   67.0 ¦  0.5745 ¦
     3 ¦      5 ¦   0.35 ¦ 3.0000 ¦   170.0 ¦    95.0 ¦   72.0 ¦  0.5916 ¦
     4 ¦      5 ¦   0.35 ¦ 3.0000 ¦   170.0 ¦   111.0 ¦   80.0 ¦  0.5916 ¦
     5 ¦      5 ¦   0.34 ¦ 2.9000 ¦   170.0 ¦   115.0 ¦   89.0 ¦  0.5831 ¦
     6 ¦      5 ¦   0.33 ¦ 2.8100 ¦   170.0 ¦   117.0 ¦   95.0 ¦  0.5745 ¦
     1 ¦      5 ¦   0.33 ¦ 2.8100 ¦   170.0 ¦    90.0 ¦   75.0 ¦  0.5745 ¦
     2 ¦      5 ¦   0.33 ¦ 2.8100 ¦   170.0 ¦   119.0 ¦  100.0 ¦  0.5745 ¦
     3 ¦      5 ¦   0.33 ¦ 2.8100 ¦   170.0 ¦   122.0 ¦  104.0 ¦  0.5745 ¦
     4 ¦      5 ¦   0.35 ¦ 3.0000 ¦   170.0 ¦   118.0 ¦  106.0 ¦  0.5916 ¦
     5 ¦      5 ¦   0.35 ¦ 3.0000 ¦   170.0 ¦   113.0 ¦  104.0 ¦  0.5916 ¦
     6 ¦      5 ¦   0.35 ¦ 3.0000 ¦   170.0 ¦   111.0 ¦  102.0 ¦  0.5916 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
     0 ¦      0 ¦   0.00 ¦ 0.0000 ¦     0.0 ¦     0.0 ¦    0.0 ¦  0.0000 ¦
-------+--------+--------+--------+----------+---------+-------+---------¦
TOTALS ¦     60 ¦   4.07 ¦34.7600 ¦  2040.0 ¦  1271.0 ¦ 1059.0 ¦  6.9879 ¦
```

```
FIELD DATA AVERAGES

 Avg Velocity Head (in H2O)             dP(avg)   =   0.339

 Avg Orifice Meter Reading (in H2O)     dH(avg)   =   2.897

 Avg Stack Temperature (degF)           T(s avg)  =   170.0

 Average Meter Temperature (degF)       T(m avg)  =    97.1

 Avg SQRT(dP)                                     =   0.582

CALCULATED VALUES

 Meter Volume (std, cu. ft.)            V(m std)  =   57.36

 Stack Gas Water Vapor Proportion       B(wo)     =   0.273

 Mol. Wt., Stack Gas Dry                M(d)      =   29.32

 Mol. Wt., Stack Gas Wet                M(s)      =   26.23

 Abs Stack Pressure (in Hg)             P(s)      =   29.99

 Avg Stack Velocity (ft/sec)            V(s avg)  =    37.4

 Isokineticity (%)                      % I       =   100.3

 Stack Gas STD Vol Flow (dscfm)         Q(s)      =    1466

 Actual Stack Gas Vol Flow (acfm)       Q(a)      =    2400

 Particulate Loading, dry(gr/dscf)      C(s std)  =  0.0086
 Particulate Loading, @7% O2(mg/dscm)C(s std)     =      39
 Particulate Loading, dry @ 7 % O2 (gr/dscf)      =  0.0171

 Particulate Emission Rate(lb/hr)       E(p)      =   0.109
```

APPENDIX C

ANALYTICAL LABORATORY DATA

ACUREX
Corporation

Environmental Systems Division

Acurex

March 10, 1988
Acurex ID: 8801048
Client PO: 8281.14
Page 1 of 17
Rev. 8/10/88

Attention: Larry Waterland

Subject: Analysis of 21 Extracts, Received 1/22/88.

Extracts were analyzed for semivolatile organic compounds according to U.S. EPA Method 8270 (Test Methods for Evaluating Solid Waste - SW846, 2nd Ed.,1982). Results are presented in Table 1. The method can be summarized as follows:

> Prior to injection into a Gas Chromatograph/Mass Spectrometer (GC/MS), the extract is combined with internal standards. The GC/MS is equipped with a fused silica capillary column and is set up for the analysis of semivolatile priority pollutants.

Identification and quantitation of other semivolatile compounds is presented in Table 2.

Qualitative identification of the priority pollutants is performed initially using the relative retention times and the relative abundance of three unique ions. The entire mass spectrum is checked before any final identifications are recorded. Quantitative analysis is performed by the internal standard method using a single characteristic ion and response factors obtained from a daily calibration standard. In the tables, an entry such as "<5" means that the compound was not found at a level above the laboratory's reporting limit. The reporting limit, which is based on EPA reporting levels, has been corrected for any sample dilution.

Please note that the results for analysis of the extracts are presented in micrograms per extract. The surrogate recoveries are given in concentration rather than percent recoveries.

If you should have any technical questions, please contact Robert DeRosier at (415)961-5700.

Submitted by: Richard Scott
Richard Scott
Acting GC Supervisor

Approved by:
Robert DeRosier
Client Services Manager

These results were obtained by following standard laboratory procedures; the liability of Acurex Corporation shall not exceed the amount paid for this report. In no event shall Acurex be liable for special or consequential damages.

Table 1. Semivolatile Organic Results

ACUREX Sample ID

8270 Compounds	E1217 1145	S1217 1145	B1217 1545	T1217 1200	E1209 1310T1
	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Phenol	<40	<40	<40	<40	<40
Bis(2-chloroethyl)ether	<40	<40	<40	<40	<40
2-Chlorophenol	<40	<40	<40	<40	<40
1,3-Dichlorobenzene	<40	<40	<40	<40	<40
1,4-Dichlorobenzene	<40	<40	<40	<40	<40
1,2-Dichlorobenzene	<40	<40	<40	<40	<40
Bis(2-chloroisopropyl)ether	<40	<40	<40	<40	<40
N-Nitroso-di-n-propylamine	<40	<40	<40	<40	<40
Hexachloroethane	<40	<40	<40	<40	<40
Nitrobenzene	<40	<40	<40	<40	<40
Isophorone	<40	<40	<40	<40	<40
2-Nitrophenol	<40	<40	<40	<40	<40
2,4-Dimethylphenol	<40	<40	<40	<40	<40
Bis(2-chloroethoxy)methane	<40	<40	<40	<40	<40
2,4-Dichlorophenol	<40	<40	<40	<40	<40
1,2,4-Trichlorobenzene	<40	<40	<40	<40	<40
Naphthalene	<40	<40	<40	<40	<40
Hexachlorobutadiene	<40	<40	<40	<40	<40
4-Chloro-3-methylphenol	<40	<40	<40	<40	<40
Hexachlorocyclopentadiene	<40	<40	<40	<40	<40
2,4,6-Trichlorophenol	<40	<40	<40	<40	<40
2-Chloronaphthalene	<40	<40	<40	<40	<40
Dimethyl phthalate	<40	<40	<40	<40	<40
Acenaphthylene	<40	<40	<40	<40	<40
Acenaphthene	<40	<40	<40	<40	<40
2,4-Dinitrophenol	<200	<200	<200	<200	<200
4-Nitrophenol	<200	<200	<200	<200	<200
2,4-Dinitrotoluene	<40	<40	<40	<40	<40
2,6-Dinitrotoluene	<40	<40	<40	<40	<40
Diethyl phthalate	<40	<40	<40	<40	<40
4-Chlorophenyl phenylether	<40	<40	<40	<40	<40
Fluorene	<40	<40	<40	<40	<40
4,6-Dinitro-2-methylphenol	<200	<200	<200	<200	<200
N-Nitrosodiphenylamine	<40	<40	<40	<40	<40
4-Bromophenyl phenylether	<40	<40	<40	<40	<40
Hexachlorobenzene	<40	<40	<40	<40	<40
Pentachlorophenol	<200	<200	<200	<200	<200
Phenanthrene	<40	<40	<40	<40	<40
Anthracene	<40	<40	<40	<40	<40
Di-n-Butyl phthalate	<40	<40	<40	<40	<40

Table 1. Semivolatile Organic Results (Continued)

ACUREX Sample ID

8270 Compounds	E1217 1145	S1217 1145	B1217 1545	T1217 1200	E1209 1310T1
	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Fluoranthene	<40	<40	<40	<40	<40
Pyrene	<40	<40	<40	<40	<40
Butyl benzyl phthalate	<40	<40	<40	<40	<40
3,3'-Dichlorobenzidine	<80	<80	<80	<80	<80
Benzo(a)anthracene	<40	<40	<40	<40	<40
Bis(2-ethylhexyl)phthalate	120	120	<40	<40	120
Chrysene	<40	<40	<40	<40	<40
Di-n-octyl phthalate	88	<40	<40	<40	<40
Benzo(b)fluoranthene	<40	<40	<40	<40	<40
Benzo(k)fluoranthene	<40	<40	<40	<40	<40
Benzo(a)pyrene	<40	<40	<40	<40	<40
Indeno(1,2,3-cd)pyrene	<40	<40	<40	<40	<40
Dibenzo(a,h)anthracene	<40	<40	<40	<40	<40
Benzo(g,h,i)perylene	<40	<40	<40	<40	<40
alpha-BHC	<40	<40	<40	<40	<40
beta-BHC	<40	<40	<40	<40	<40
gamma-BHC	<40	<40	<40	<40	<40
delta-BHC	<40	<40	<40	<40	<40
Heptachlor	<40	<40	<40	<40	<40
Aldrin	<40	<40	<40	<40	<40
Heptachlor epoxide	<40	<40	<40	<40	<40
Endosulfan I	<40	<40	<40	<40	<40
Dieldrin	<40	<40	<40	<40	<40
4,4'-DDE	<40	<40	<40	<40	<40
Endrin	<40	<40	<40	<40	<40
Endosulfan II	<40	<40	<40	<40	<40
4,4'-DDD	<40	<40	<40	<40	<40
Endrin aldehyde	<40	<40	<40	<40	<40
Endosulfan sulfate	<40	<40	<40	<40	<40
4,4'-DDT	<40	<40	<40	<40	<40
PCBs	<40	<40	<40	<40	<40
Date Analyzed	1/27/88	1/27/88	1/27/88	1/27/88	1/28/88

Surrogates	Percent Recovery (%)				
Octafluorobiphenyl	77	71	ND	ND	55
9-Phenylanthracene	54	24	ND	ND	37

ND - Not detected among the major peaks examined, detection limit unknown.

Table 1. Semivolatile Organic Results (Continued)

ACUREX Sample ID

	E1209 1310T2	E1211 1159T1	E1211 1159T2	S1211 1158	B1211 1410
8270 Compounds	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Phenol	<40	<40	<200	<40	<40
Bis(2-chloroethyl)ether	<40	<40	<200	<40	<40
2-Chlorophenol	<40	<40	<200	<40	<40
1,3-Dichlorobenzene	<40	<40	<200	<40	<40
1,4-Dichlorobenzene	<40	<40	<200	<40	<40
1,2-Dichlorobenzene	<40	<40	<200	<40	<40
Bis(2-chloroisopropyl)ether	<40	<40	<200	<40	<40
N-Nitroso-di-n-propylamine	<40	<40	<200	<40	<40
Hexachloroethane	<40	<40	<200	<40	<40
Nitrobenzene	<40	<40	<200	<40	<40
Isophorone	<40	<40	<200	<40	<40
2-Nitrophenol	<40	<40	<200	<40	<40
2,4-Dimethylphenol	<40	<40	<200	<40	<40
Bis(2-chloroethoxy)methane	<40	<40	<200	<40	<40
2,4-Dichlorophenol	<40	<40	<200	<40	<40
1,2,4-Trichlorobenzene	<40	<40	<200	<40	<40
Naphthalene	<40	<40	<200	<40	<40
Hexachlorobutadiene	<40	<40	<200	<40	<40
4-Chloro-3-methylphenol	<40	<40	<200	<40	<40
Hexachlorocyclopentadiene	<40	<40	<200	<40	<40
2,4,6-Trichlorophenol	<40	<40	<200	<40	<40
2-Chloronaphthalene	<40	<40	<200	<40	<40
Dimethyl phthalate	<40	<40	<200	<40	<40
Acenaphthylene	<40	<40	<200	<40	<40
Acenaphthene	<40	<40	<200	<40	<40
2,4-Dinitrophenol	<200	<200	<1000	<200	<200
4-Nitrophenol	<200	<200	<1000	<200	<200
2,4-Dinitrotoluene	<40	<40	<200	<40	<40
2,6-Dinitrotoluene	<40	<40	<200	<40	<40
Diethyl phthalate	<40	<40	<200	<40	<40
4-Chlorophenyl phenylether	<40	<40	<200	<40	<40
Fluorene	<40	<40	<200	<40	<40
4,6-Dinitro-2-methylphenol	<200	<200	<1000	<200	<200
N-Nitrosodiphenylamine	<40	<40	<200	<40	<40
4-Bromophenyl phenylether	<40	<40	<200	<40	<40
Hexachlorobenzene	<40	<40	<200	<40	<40
Pentachlorophenol	<200	<200	<1000	<200	<200
Phenanthrene	<40	<40	<200	<40	<40
Anthracene	<40	<40	<200	<40	<40
Di-n-Butyl phthalate	<40	<40	<200	<40	<40

Table 1. Semivolatile Organic Results (Continued)

ACUREX Sample ID

8270 Compounds	E1209 1310T2	E1211 1159T1	E1211 1159T2	S1211 1158	B1211 1410
	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Fluoranthene	<40	<40	<200	<40	<40
Pyrene	<40	<40	<200	<40	<40
Butyl benzyl phthalate	<40	<40	<200	<40	<40
3,3'-Dichlorobenzidine	<80	<80	<400	<80	<80
Benzo(a)anthracene	<40	<40	<200	<40	<40
Bis(2-ethylhexyl)phthalate	680	76	2600	80	<40
Chrysene	<40	<40	<200	<40	<40
Di-n-octyl phthalate	54	<40	<200	<40	<40
Benzo(b)fluoranthene	<40	<40	<200	<40	<40
Benzo(k)fluoranthene	<40	<40	<200	<40	<40
Benzo(a)pyrene	<40	<40	<200	<40	<40
Indeno(1,2,3-cd)pyrene	<40	<40	<200	<40	<40
Dibenzo(a,h)anthracene	<40	<40	<200	<40	<40
Benzo(g,h,i)perylene	<40	<40	<200	<40	<40
alpha-BHC	<40	<40	<200	<40	<40
beta-BHC	<40	<40	<200	<40	<40
gamma-BHC	<40	<40	<200	<40	<40
delta-BHC	<40	<40	<200	<40	<40
Heptachlor	<40	<40	<200	<40	<40
Aldrin	<40	<40	<200	<40	<40
Heptachlor epoxide	<40	<40	<200	<40	<40
Endosulfan I	<40	<40	<200	<40	<40
Dieldrin	<40	<40	<200	<40	<40
4,4'-DDE	<40	<40	<200	<40	<40
Endrin	<40	<40	<200	<40	<40
Endosulfan II	<40	<40	<200	<40	<40
4,4'-DDD	<40	<40	<200	<40	<40
Endrin aldehyde	<40	<40	<200	<40	<40
Endosulfan sulfate	<40	<40	<200	<40	<40
4,4'-DDT	<40	<40	<200	<40	<40
PCBs	<40	<40	<200	<40	<40
Date Analyzed	1/28/88	1/28/88	1/28/88	1/28/88	1/28/88

Surrogates	Percent Recovery (%)				
Octafluorobiphenyl	62	71	61	67	ND
9-Phenylanthracene	46	57	18	70	ND

ND - Not detected among the major peaks examined, detection limit unknown.

Table 1. Semivolatile Organic Results (Continued)

ACUREX Sample ID

8270 Compounds	T1211 1200 ug/ext	F1217 1128 ug/ext	F1209 1725 ug/ext	F1211 1610 ug/ext	Q1217 0900 FSK ug/ext
Phenol	<40	<10000	<4000	<10000	<40
Bis(2-chloroethyl)ether	<40	<10000	<4000	<10000	<40
2-Chlorophenol	<40	<10000	<4000	<10000	<40
1,3-Dichlorobenzene	<40	<10000	<4000	<10000	<40
1,4-Dichlorobenzene	<40	<10000	<4000	<10000	<40
1,2-Dichlorobenzene	<40	<10000	<4000	<10000	<40
Bis(2-chloroisopropyl)ether	<40	<10000	<4000	<10000	<40
N-Nitroso-di-n-propylamine	<40	<10000	<4000	<10000	<40
Hexachloroethane	<40	<10000	<4000	<10000	<40
Nitrobenzene	<40	<10000	<4000	<10000	<40
Isophorone	<40	<10000	<4000	<10000	<40
2-Nitrophenol	<40	<10000	<4000	<10000	<40
2,4-Dimethylphenol	<40	<10000	<4000	<10000	<40
Bis(2-chloroethoxy)methane	<40	<10000	<4000	<10000	<40
2,4-Dichlorophenol	<40	<10000	<4000	<10000	<40
1,2,4-Trichlorobenzene	<40	<10000	<4000	<10000	<40
Naphthalene	<40	120000	34000	130000	33
Hexachlorobutadiene	<40	<10000	<4000	<10000	<40
4-Chloro-3-methylphenol	<40	<10000	<4000	<10000	<40
Hexachlorocyclopentadiene	<40	<10000	<4000	<10000	<40
2,4,6-Trichlorophenol	<40	<10000	<4000	<10000	<40
2-Chloronaphthalene	<40	<10000	<4000	<10000	<40
Dimethyl phthalate	<40	<10000	<4000	<10000	<40
Acenaphthylene	<40	28000	10000	16000	48
Acenaphthene	<40	<10000	<4000	<10000	<40
2,4-Dinitrophenol	<200	<50000	<20000	<50000	<200
4-Nitrophenol	<200	<50000	<20000	<50000	<200
2,4-Dinitrotoluene	<40	<10000	<4000	<10000	<40
2,6-Dinitrotoluene	<40	<10000	<4000	<10000	<40
Diethyl phthalate	<40	<10000	<4000	<10000	<40
4-Chlorophenyl phenylether	<40	<10000	<4000	<10000	<40
Fluorene	<40	21000	5500	17000	38
4,6-Dinitro-2-methylphenol	<200	<50000	<20000	<50000	<200
N-Nitrosodiphenylamine	<40	<10000	<4000	<10000	<40
4-Bromophenyl phenylether	<40	<10000	<4000	<10000	<40
Hexachlorobenzene	<40	<10000	<4000	<10000	<40
Pentachlorophenol	<200	<50000	<20000	<50000	<200
Phenanthrene	<40	62000	19000	60000	39
Anthracene	<40	18000	5500	17000	44
Di-n-Butyl phthalate	<40	<10000	<4000	<10000	<40

Table 1. Semivolatile Organic Results (Continued)

ACUREX Sample ID

8270 Compounds	T1211 1200 ug/ext	F1217 1128 ug/ext	F1209 1725 ug/ext	F1211 1610 ug/ext	Q1217 0900FSK ug/ext
Fluoranthene	<40	32000	8400	27000	37
Pyrene	<40	23000	8400	34000	<40
Butyl benzyl phthalate	<40	<10000	<4000	<10000	<40
3,3'-Dichlorobenzidine	<80	<20000	<8000	<20000	<80
Benzo(a)anthracene	<40	11000	<4000	13000	<40
Bis(2-ethylhexyl)phthalate	<40	<10000	<4000	<10000	<40
Chrysene	<40	<10000	<4000	14000	<40
Di-n-octyl phthalate	<40	<10000	<4000	<10000	<40
Benzo(b)fluoranthene	<40	<10000	<4000	10000	<40
Benzo(k)fluoranthene	<40	<10000	<4000	11000	<40
Benzo(a)pyrene	<40	<10000	<4000	12000	<40
Indeno(1,2,3-cd)pyrene	<40	<10000	<4000	<10000	<40
Dibenzo(a,h)anthracene	<40	<10000	<4000	<10000	<40
Benzo(g,h,i)perylene	<40	<10000	<4000	<10000	<40
alpha-BHC	<40	<10000	<4000	<10000	<40
beta-BHC	<40	<10000	<4000	<10000	<40
gamma-BHC	<40	<10000	<4000	<10000	<40
delta-BHC	<40	<10000	<4000	<10000	<40
Heptachlor	<40	<10000	<4000	<10000	<40
Aldrin	<40	<10000	<4000	<10000	<40
Heptachlor epoxide	<40	<10000	<4000	<10000	<40
Endosulfan I	<40	<10000	<4000	<10000	<40
Dieldrin	<40	<10000	<4000	<10000	<40
4,4'-DDE	<40	<10000	<4000	<10000	<40
Endrin	<40	<10000	<4000	<10000	<40
Endosulfan II	<40	<10000	<4000	<10000	<40
4,4'-DDD	<40	<10000	<4000	<10000	<40
Endrin aldehyde	<40	<10000	<4000	<10000	<40
Endosulfan sulfate	<40	<10000	<4000	<10000	<40
4,4'-DDT	<40	<10000	<4000	<10000	<40
PCBs	<40	<10000	<4000	<10000	<40
Date Analyzed	2/3/88	2/3/88	2/3/88	2/3/88	2/3/88

Surrogates	Percent Recovery (%)				
Octafluorobiphenyl	ND	ND	ND	ND	157
9-Phenylanthracene	ND	ND	ND	ND	154

ND - Not detected among the major peaks examined, detection limit unknown.

Table 1. Semivolatile Organic Results (Continued)

ACUREX Sample ID

8270 Compounds	Q1219 0850	Q1209 0905BK	Q1209 1330IBK	Q1209 0909SK	Q1211 0908SK
	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Phenol	<20	<40	<20	<40	<40
Bis(2-chloroethyl)ether	<20	<40	<20	<40	<40
2-Chlorophenol	<20	<40	<20	<40	<40
1,3-Dichlorobenzene	<20	<40	<20	<40	<40
1,4-Dichlorobenzene	<20	<40	<20	<40	<40
1,2-Dichlorobenzene	<20	<40	<20	<40	<40
Bis(2-chloroisopropyl)ether	<20	<40	<20	<40	<40
N-Nitroso-di-n-propylamine	<20	<40	<20	<40	<40
Hexachloroethane	<20	<40	<20	<40	<40
Nitrobenzene	<20	<40	<20	<40	<40
Isophorone	<20	<40	<20	<40	<40
2-Nitrophenol	<20	<40	<20	<40	<40
2,4-Dimethylphenol	<20	<40	<20	<40	<40
Bis(2-chloroethoxy)methane	<20	<40	<20	<40	<40
2,4-Dichlorophenol	<20	<40	<20	<40	<40
1,2,4-Trichlorobenzene	<20	<40	<20	<40	<40
Naphthalene	<20	<40	<20	33	31
Hexachlorobutadiene	<20	<40	<20	<40	<40
4-Chloro-3-methylphenol	<20	<40	<20	<40	<40
Hexachlorocyclopentadiene	<20	<40	<20	<40	<40
2,4,6-Trichlorophenol	<20	<40	<20	<40	<40
2-Chloronaphthalene	<20	<40	<20	<40	<40
Dimethyl phthalate	<20	<40	<20	<40	<40
Acenaphthylene	<20	<40	<20	44	46
Acenaphthene	<20	<40	<20	<40	<40
2,4-Dinitrophenol	<100	<200	<100	<200	<200
4-Nitrophenol	<100	<200	<100	<200	<200
2,4-Dinitrotoluene	<20	<40	<20	<40	<40
2,6-Dinitrotoluene	<20	<40	<20	<40	<40
Diethyl phthalate	<20	<40	<20	<40	<40
4-Chlorophenyl phenylether	<20	<40	<20	<40	<40
Fluorene	<20	<40	<20	32	35
4,6-Dinitro-2-methylphenol	<100	<200	<100	<200	<200
N-Nitrosodiphenylamine	<20	<40	<20	<40	<40
4-Bromophenyl phenylether	<20	<40	<20	<40	<40
Hexachlorobenzene	<20	<40	<20	<40	<40
Pentachlorophenol	<100	<200	<100	<200	<200
Phenanthrene	<20	<40	<20	37	40
Anthracene	<20	<40	<20	42	46
Di-n-Butyl phthalate	<20	<40	<20	<40	<40

Table 1. Semivolatile Organic Results (Continued)

ACUREX Sample ID

8270 Compounds	Q1219 0850 ug/ext	Q1209 0905BK ug/ext	Q1209 1330IBK ug/ext	Q1209 0909SK ug/ext	Q1211 0908SK ug/ext
Phenol	<20	<40	<20	<40	<40
Bis(2-chloroethyl)ether	<20	<40	<20	<40	<40
2-Chlorophenol	<20	<40	<20	<40	<40
1,3-Dichlorobenzene	<20	<40	<20	<40	<40
1,4-Dichlorobenzene	<20	<40	<20	<40	<40
1,2-Dichlorobenzene	<20	<40	<20	<40	<40
Bis(2-chloroisopropyl)ether	<20	<40	<20	<40	<40
N-Nitroso-di-n-propylamine	<20	<40	<20	<40	<40
Hexachloroethane	<20	<40	<20	<40	<40
Nitrobenzene	<20	<40	<20	<40	<40
Isophorone	<20	<40	<20	<40	<40
2-Nitrophenol	<20	<40	<20	<40	<40
2,4-Dimethylphenol	<20	<40	<20	<40	<40
Bis(2-chloroethoxy)methane	<20	<40	<20	<40	<40
2,4-Dichlorophenol	<20	<40	<20	<40	<40
1,2,4-Trichlorobenzene	<20	<40	<20	<40	<40
Naphthalene	<20	<40	<20	33	31
Hexachlorobutadiene	<20	<40	<20	<40	<40
4-Chloro-3-methylphenol	<20	<40	<20	<40	<40
Hexachlorocyclopentadiene	<20	<40	<20	<40	<40
2,4,6-Trichlorophenol	<20	<40	<20	<40	<40
2-Chloronaphthalene	<20	<40	<20	<40	<40
Dimethyl phthalate	<20	<40	<20	<40	<40
Acenaphthylene	<20	<40	<20	44	46
Acenaphthene	<20	<40	<20	<40	<40
2,4-Dinitrophenol	<100	<200	<100	<200	<200
4-Nitrophenol	<100	<200	<100	<200	<200
2,4-Dinitrotoluene	<20	<40	<20	<40	<40
2,6-Dinitrotoluene	<20	<40	<20	<40	<40
Diethyl phthalate	<20	<40	<20	<40	<40
4-Chlorophenyl phenylether	<20	<40	<20	<40	<40
Fluorene	<20	<40	<20	32	35
4,6-Dinitro-2-methylphenol	<100	<200	<100	<200	<200
N-Nitrosodiphenylamine	<20	<40	<20	<40	<40
4-Bromophenyl phenylether	<20	<40	<20	<40	<40
Hexachlorobenzene	<20	<40	<20	<40	<40
Pentachlorophenol	<100	<200	<100	<200	<200
Phenanthrene	<20	<40	<20	37	40
Anthracene	<20	<40	<20	42	46
Di-n-Butyl phthalate	<20	<40	<20	<40	<40

Table 1. Semivolatile Organic Results (Continued)

ACUREX Sample ID

8270 Compounds	Q1219 0850 ug/ext	Q1209 0905BK ug/ext	Q1209 1330IBK ug/ext	Q1209 0909SK ug/ext	Q1211 0908SK ug/ext
Fluoranthene	<20	<40	<20	36	38
Pyrene	<20	<40	<20	<40	<40
Butyl benzyl phthalate	<20	<40	<20	<40	<40
3,3'-Dichlorobenzidine	<40	<80	<40	<80	<80
Benzo(a)anthracene	<20	<40	<20	<40	<40
Bis(2-ethylhexyl)phthalate	<20	<40	<20	<40	<40
Chrysene	<20	<40	<20	<40	<40
Di-n-octyl phthalate	<20	<40	<20	<40	<40
Benzo(b)fluoranthene	<20	<40	<20	<40	<40
Benzo(k)fluoranthene	<20	<40	<20	<40	<40
Benzo(a)pyrene	<20	<40	<20	<40	<40
Indeno(1,2,3-cd)pyrene	<20	<40	<20	<40	<40
Dibenzo(a,h)anthracene	<20	<40	<20	<40	<40
Benzo(g,h,i)perylene	<20	<40	<20	<40	<40
alpha-BHC	<20	<40	<20	<40	<40
beta-BHC	<20	<40	<20	<40	<40
gamma-BHC	<20	<40	<20	<40	<40
delta-BHC	<20	<40	<20	<40	<40
Heptachlor	<20	<40	<20	<40	<40
Aldrin	<20	<40	<20	<40	<40
Heptachlor epoxide	<20	<40	<20	<40	<40
Endosulfan I	<20	<40	<20	<40	<40
Dieldrin	<20	<40	<20	<40	<40
4,4'-DDE	<20	<40	<20	<40	<40
Endrin	<20	<40	<20	<40	<40
Endosulfan II	<20	<40	<20	<40	<40
4,4'-DDD	<20	<40	<20	<40	<40
Endrin aldehyde	<20	<40	<20	<40	<40
Endosulfan sulfate	<20	<40	<20	<40	<40
4,4'-DDT	<20	<40	<20	<40	<40
PCBs	<20	<40	<20	<40	<40
Date Analyzed	2/3/88	2/3/88	2/3/88	2/3/88	2/3/88

Surrogates	Percent Recovery (%)				
Octafluorobiphenyl	ND	97	ND	83	86
9-Phenylanthracene	ND	90	ND	78	94

ND - Not detected among the major peaks examined, detection limit unknown.

Table 1. Semivolatile Organic Results (Continued)

ACUREX Sample ID

8270 Compounds	Q1211 0854BK ug/ext
Phenol	<40
Bis(2-chloroethyl)ether	<40
2-Chlorophenol	<40
1,3-Dichlorobenzene	<40
1,4-Dichlorobenzene	<40
1,2-Dichlorobenzene	<40
Bis(2-chloroisopropyl)ether	<40
N-Nitroso-di-n-propylamine	<40
Hexachloroethane	<40
Nitrobenzene	<40
Isophorone	<40
2-Nitrophenol	<40
2,4-Dimethylphenol	<40
Bis(2-chloroethoxy)methane	<40
2,4-Dichlorophenol	<40
1,2,4-Trichlorobenzene	<40
Naphthalene	<40
Hexachlorobutadiene	<40
4-Chloro-3-methylphenol	<40
Hexachlorocyclopentadiene	<40
2,4,6-Trichlorophenol	<40
2-Chloronaphthalene	<40
Dimethyl phthalate	<40
Acenaphthylene	<40
Acenaphthene	<40
2,4-Dinitrophenol	<200
4-Nitrophenol	<200
2,4-Dinitrotoluene	<40
2,6-Dinitrotoluene	<40
Diethyl phthalate	<40
4-Chlorophenyl phenylether	<40
Fluorene	<40
4,6-Dinitro-2-methylphenol	<200
N-Nitrosodiphenylamine	<40
4-Bromophenyl phenylether	<40
Hexachlorobenzene	<40
Pentachlorophenol	<200
Phenanthrene	<40
Anthracene	<40
Di-n-Butyl phthalate	<40

Table 1. Semivolatile Organic Results (Continued)

ACUREX Sample ID

8270 Compounds	Q1211 0854BK ug/ext
Phenol	<40
Bis(2-chloroethyl)ether	<40
2-Chlorophenol	<40
1,3-Dichlorobenzene	<40
1,4-Dichlorobenzene	<40
1,2-Dichlorobenzene	<40
Bis(2-chloroisopropyl)ether	<40
N-Nitroso-di-n-propylamine	<40
Hexachloroethane	<40
Nitrobenzene	<40
Isophorone	<40
2-Nitrophenol	<40
2,4-Dimethylphenol	<40
Bis(2-chloroethoxy)methane	<40
2,4-Dichlorophenol	<40
1,2,4-Trichlorobenzene	<40
Naphthalene	<40
Hexachlorobutadiene	<40
4-Chloro-3-methylphenol	<40
Hexachlorocyclopentadiene	<40
2,4,6-Trichlorophenol	<40
2-Chloronaphthalene	<40
Dimethyl phthalate	<40
Acenaphthylene	<40
Acenaphthene	<40
2,4-Dinitrophenol	<200
4-Nitrophenol	<200
2,4-Dinitrotoluene	<40
2,6-Dinitrotoluene	<40
Diethyl phthalate	<40
4-Chlorophenyl phenylether	<40
Fluorene	<40
4,6-Dinitro-2-methylphenol	<200
N-Nitrosodiphenylamine	<40
4-Bromophenyl phenylether	<40
Hexachlorobenzene	<40
Pentachlorophenol	<200
Phenanthrene	<40
Anthracene	<40
Di-n-Butyl phthalate	<40

Table 1. Semivolatile Organic Results (Continued)

8270 Compounds	ACUREX Sample ID Q1211 0854BK ug/ext
Fluoranthene	<40
Pyrene	<40
Butyl benzyl phthalate	<40
3,3'-Dichlorobenzidine	<80
Benzo(a)anthracene	<40
Bis(2-ethylhexyl)phthalate	<40
Chrysene	<40
Di-n-octyl phthalate	<40
Benzo(b)fluoranthene	<40
Benzo(k)fluoranthene	<40
Benzo(a)pyrene	<40
Indeno(1,2,3-cd)pyrene	<40
Dibenzo(a,h)anthracene	<40
Benzo(g,h,i)perylene	<40
alpha-BHC	<40
beta-BHC	<40
gamma-BHC	<40
delta-BHC	<40
Heptachlor	<40
Aldrin	<40
Heptachlor epoxide	<40
Endosulfan I	<40
Dieldrin	<40
4,4'-DDE	<40
Endrin	<40
Endosulfan II	<40
4,4'-DDD	<40
Endrin aldehyde	<40
Endosulfan sulfate	<40
4,4'-DDT	<40
PCBs	<40
Date Analyzed	2/3/88

Surrogates	Percent Recovery (%)
Octafluorobiphenyl	76
9-Phenylanthracene	80

ND - Not detected among the major peaks examined, dete

Table 2. Other Identified Compounds

ACUREX Sample ID

Semivolatile Compounds	E1217 1145 ug/ext	S1217 1145 ug/ext	B1217 1545 ug/ext	T1217 1200 ug/ext	E1209 1310T1 ug/ext
2-Methylnaphthalene	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND
4-Methylphenol	ND	ND	ND	ND	ND

ND - Not detected among the major peaks examined, detection limit unknown.

Table 2. Other Identified Compounds

	ACUREX Sample ID				
	E1209 1310T2	E1211 1159T1	E1211 1159T2	S1211 1158	B1211 1410
Semivolatile Compounds	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
2-Methylnaphthalene	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND
4-Methylphenol	ND	ND	ND	ND	ND

ND - Not detected among the major peaks examined, detection limit unknown.

Table 2. Other Identified Compounds

	ACUREX Sample ID				
	T1211 1200	F1217 1128	F1209 1725	F1211 1610	Q1217 0900 FSK
Semivolatile Compounds	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
2-Methylnaphthalene	ND	12	6	9	ND
Dibenzofuran	ND	15	10	13	ND
4-Methylphenol	ND	ND	ND	ND	ND

ND - Not detected among the major peaks examined, detection limit unknown.

Table 2. Other Identified Compounds

ACUREX Sample ID

Semivolatile Compounds	Q1219 0850 ug/ext	Q1209 0905BK ug/ext	Q1209 1330IBK ug/ext	Q1209 0909SK ug/ext	Q1211 0908SK ug/ext
2-Methylnaphthalene	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND
4-Methylphenol	ND	ND	ND	ND	ND

ND - Not detected among the major peaks examined, detection limit unknown.

Table 2. Other Identified Compounds

	ACUREX Sample ID
	Q1211 0854BK
Semivolatile Compounds	ug/ext
2-Methylnaphthalene	ND
Dibenzofuran	ND
4-Methylphenol	ND

ND - Not detected among the major peaks examined, detection limit unknown.

ACUREX
Corporation

Environmental Systems Division

Acurex (CRF)

March 30, 1988
Acurex ID: 8802040
Client PO: 8281.14
Page 1 of 8

Attention: Larry Waterland

Subject: Analysis of 8 Extracts, Received 2/17 and 2/18/88.

Extracts were analyzed for semivolatile organic compounds according to U.S. EPA Method 8270 (Test Methods for Evaluating Solid Waste - SW846, 2nd Ed.,1982). Results are presented in Table 1. The method can be summarized as follows:

> Prior to injection into a Gas Chromatograph/Mass Spectrometer (GC/MS), the extract is combined with internal standards. The GC/MS is equipped with a fused silica capillary column and is set up for the analysis of semivolatile priority pollutants.

Identification and quantitation of other semivolatile compounds is presented in Table 2.

Qualitative identification of the priority pollutants is performed initially using the relative retention times and the relative abundance of three unique ions. The entire mass spectrum is checked before any final identifications are recorded. Quantitative analysis is performed by the internal standard method using a single characteristic ion and response factors obtained from a daily calibration standard. In the tables, an entry such as "<5" means that the compound was not found at a level above the laboratory's reporting limit.

Please note that the results are reported as micrograms per extract, and that the two surrogates, octafluorobiphenyl and 9-phenylanthracene, are reported in concentration instead of percent recoveries.

If you should have any technical questions, please contact Susan M. Schrader at (415)961-5700.

Submitted by: Richard Scott Approved by: Susan Schrader

Richard Scott
Supervisor, Organic Chemistry

Susan M. Schrader
Client Services Manager

These results were obtained by following standard laboratory procedures; the liability of Acurex Corporation shall not exceed the amount paid for this report. In no event shall Acurex be liable for special or consequential damages.

Table 1. Semivolatile Organic Results

Acurex Sample ID

8270 Compounds	B1211 1410 ug/ext	B1217 1545 ug/ext	T1209 1700 ug/ext	T1211 1200 ug/ext	T1217 1200 ug/ext
Phenol	<20	<20	<20	<20	<20
Bis(2-chloroethyl)ether	<20	<20	<20	<20	<20
2-Chlorophenol	<20	<20	<20	<20	<20
1,3-Dichlorobenzene	<20	<20	<20	<20	<20
1,4-Dichlorobenzene	<20	<20	<20	<20	<20
1,2-Dichlorobenzene	<20	<20	<20	<20	<20
Bis(2-chloroisopropyl)ether	<20	<20	<20	<20	<20
N-Nitroso-di-n-propylamine	<20	<20	<20	<20	<20
Hexachloroethane	<20	<20	<20	<20	<20
Nitrobenzene	<20	<20	<20	<20	<20
Isophorone	<20	<20	<20	<20	<20
2-Nitrophenol	<20	<20	<20	<20	<20
2,4-Dimethylphenol	<20	<20	<20	<20	<20
Bis(2-chloroethoxy)methane	<20	<20	<20	<20	<20
2,4-Dichlorophenol	<20	<20	<20	<20	<20
1,2,4-Trichlorobenzene	<20	<20	<20	<20	<20
Naphthalene	<20	<20	<20	<20	<20
Hexachlorobutadiene	<20	<20	<20	<20	<20
4-Chloro-3-methylphenol	<20	<20	<20	<20	<20
Hexachlorocyclopentadiene	<20	<20	<20	<20	<20
2,4,6-Trichlorophenol	<20	<20	<20	<20	<20
2-Chloronaphthalene	<20	<20	<20	<20	<20
Dimethyl phthalate	<20	<20	<20	<20	<20
Acenaphthylene	<20	<20	<20	<20	<20
Acenaphthene	<20	<20	<20	<20	<20
2,4-Dinitrophenol	<100	<100	<100	<100	<100
4-Nitrophenol	<100	<100	<100	<100	<100
2,4-Dinitrotoluene	<20	<20	<20	<20	<20
2,6-Dinitrotoluene	<20	<20	<20	<20	<20
Diethyl phthalate	<20	<20	<20	<20	<20
4-Chlorophenyl phenylether	<20	<20	<20	<20	<20
Fluorene	<20	<20	<20	<20	<20
4,6-Dinitro-2-methylphenol	<100	<100	<100	<100	<100
N-Nitrosodiphenylamine	<20	<20	<20	<20	<20
4-Bromophenyl phenylether	<20	<20	<20	<20	<20
Hexachlorobenzene	<20	<20	<20	<20	<20
Pentachlorophenol	<100	<100	<100	<100	<100
Phenanthrene	<20	<20	<20	<20	<20
Anthracene	<20	<20	<20	<20	<20
Di-n-Butyl phthalate	<20	<20	<20	<20	<20

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

8270 Compounds	B1211 1410 ug/ext	B1217 1545 ug/ext	T1209 1700 ug/ext	T1211 1200 ug/ext	T1217 1200 ug/ext
Fluoranthene	<20	<20	<20	<20	<20
Pyrene	<20	<20	<20	<20	<20
Butyl benzyl phthalate	<20	<20	<20	<20	<20
3,3'-Dichlorobenzidine	<40	<40	<40	<40	<40
Benzo(a)anthracene	<20	<20	<20	<20	<20
Bis(2-ethylhexyl)phthalate	<20	<20	<20	<20	<20
Chrysene	<20	<20	<20	<20	<20
Di-n-octyl phthalate	<20	<20	<20	<20	<20
Benzo(b)fluoranthene	<20	<20	<20	<20	<20
Benzo(k)fluoranthene	<20	<20	<20	<20	<20
Benzo(a)pyrene	<20	<20	<20	<20	<20
Indeno(1,2,3-cd)pyrene	<20	<20	<20	<20	<20
Dibenzo(a,h)anthracene	<20	<20	<20	<20	<20
Benzo(g,h,i)perylene	<20	<20	<20	<20	<20
alpha-BHC	<20	<20	<20	<20	<20
beta-BHC	<20	<20	<20	<20	<20
gamma-BHC	<20	<20	<20	<20	<20
delta-BHC	<20	<20	<20	<20	<20
Heptachlor	<20	<20	<20	<20	<20
Aldrin	<20	<20	<20	<20	<20
Heptachlor epoxide	<20	<20	<20	<20	<20
Endosulfan I	<20	<20	<20	<20	<20
Dieldrin	<20	<20	<20	<20	<20
4,4'-DDE	<20	<20	<20	<20	<20
Endrin	<20	<20	<20	<20	<20
Endosulfan II	<20	<20	<20	<20	<20
4,4'-DDD	<20	<20	<20	<20	<20
Endrin aldehyde	<20	<20	<20	<20	<20
Endosulfan sulfate	<20	<20	<20	<20	<20
4,4'-DDT	<20	<20	<20	<20	<20
PCBs	<20	<20	<20	<20	<20
Date Analyzed	3/17/88	3/17/88	3/17/88	3/17/88	3/17/88

Surrogates	Percent Recovery (%)				
Octafluorobiphenyl	12	18	35	39	47
9-Phenylanthracene	78	74	94	75	62

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

	F1209	F1211	F1217
	1725	1610	1128
8270 Compounds	ug/ext	ug/ext	ug/ext
Phenol	<6700	<5000	<2900
Bis(2-chloroethyl)ether	<6700	<5000	<2900
2-Chlorophenol	<6700	<5000	<2900
1,3-Dichlorobenzene	<6700	<5000	<2900
1,4-Dichlorobenzene	<6700	<5000	<2900
1,2-Dichlorobenzene	<6700	<5000	<2900
Bis(2-chloroisopropyl)ether	<6700	<5000	<2900
N-Nitroso-di-n-propylamine	<6700	<5000	<2900
Hexachloroethane	<6700	<5000	<2900
Nitrobenzene	<6700	<5000	<2900
Isophorone	<6700	<5000	<2900
2-Nitrophenol	<6700	<5000	<2900
2,4-Dimethylphenol	<6700	<5000	<2900
Bis(2-chloroethoxy)methane	<6700	<5000	<2900
2,4-Dichlorophenol	<6700	<5000	<2900
1,2,4-Trichlorobenzene	<6700	<5000	<2900
Naphthalene	61000	48000	34000
Hexachlorobutadiene	<6700	<5000	<2900
4-Chloro-3-methylphenol	<6700	<5000	<2900
Hexachlorocyclopentadiene	<6700	<5000	<2900
2,4,6-Trichlorophenol	<6700	<5000	<2900
2-Chloronaphthalene	<6700	<5000	<2900
Dimethyl phthalate	<6700	<5000	<2900
Acenaphthylene	16000	11000	7800
Acenaphthene	<6700	<5000	<2900
2,4-Dinitrophenol	<33000	<25000	<14000
4-Nitrophenol	<33000	<25000	<14000
2,4-Dinitrotoluene	<6700	<5000	<2900
2,6-Dinitrotoluene	<6700	<5000	<2900
Diethyl phthalate	<6700	<5000	<2900
4-Chlorophenyl phenylether	<6700	<5000	<2900
Fluorene	7300	5400	5600
4,6-Dinitro-2-methylphenol	<33000	<25000	<14000
N-Nitrosodiphenylamine	<6700	<5000	<2900
4-Bromophenyl phenylether	<6700	<5000	<2900
Hexachlorobenzene	<6700	<5000	<2900
Pentachlorophenol	<33000	<25000	<14000
Phenanthrene	28000	22000	17000
Anthracene	8300	6600	5300
Di-n-Butyl phthalate	<6700	<5000	<2900

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

8270 Compounds	F1209 1725 ug/ext	F1211 1610 ug/ext	F1217 1128 ug/ext
Fluoranthene	19000	14000	8900
Pyrene	15000	11000	9800
Butyl benzyl phthalate	<6700	<5000	<2900
3,3'-Dichlorobenzidine	<13000	<10000	<5700
Benzo(a)anthracene	<6700	<5000	3800
Bis(2-ethylhexyl)phthalate	<6700	<5000	<2900
Chrysene	<6700	<5000	3900
Di-n-octyl phthalate	<6700	<5000	<2900
Benzo(b)fluoranthene	<6700	<5000	3700
Benzo(k)fluoranthene	<6700	<5000	<2900
Benzo(a)pyrene	<6700	<5000	<2900
Indeno(1,2,3-cd)pyrene	<6700	<5000	<2900
Dibenzo(a,h)anthracene	<6700	<5000	<2900
Benzo(g,h,i)perylene	<6700	<5000	<2900
alpha-BHC	<6700	<5000	<2900
beta-BHC	<6700	<5000	<2900
gamma-BHC	<6700	<5000	<2900
delta-BHC	<6700	<5000	<2900
Heptachlor	<6700	<5000	<2900
Aldrin	<6700	<5000	<2900
Heptachlor epoxide	<6700	<5000	<2900
Endosulfan I	<6700	<5000	<2900
Dieldrin	<6700	<5000	<2900
4,4'-DDE	<6700	<5000	<2900
Endrin	<6700	<5000	<2900
Endosulfan II	<6700	<5000	<2900
4,4'-DDD	<6700	<5000	<2900
Endrin aldehyde	<6700	<5000	<2900
Endosulfan sulfate	<6700	<5000	<2900
4,4'-DDT	<6700	<5000	<2900
PCBs	<6700	<5000	<2900
Date Analyzed	3/21/88	3/21/88	3/21/88

Surrogates	Percent Recovery (%)		
Octafluorobiphenyl	105	79	100
9-Phenylanthracene	111	75	123

Table 2. Other Identified Compounds

	Acurex Sample ID				
	B1211 1410	B1217 1545	T1209 1700	T1211 1200	T1217 1200
Semivolatile Compounds	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
2-Methylnapthalene	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND
Fatty acid esters	61	260	130	160	29
Unknown PNA's	ND	ND	ND	ND	ND
Unknown hydrocarbons	10	ND	ND	ND	ND
Other unknowns	61	ND	ND	ND	ND

ND - Not detected among the major peaks examined, detection limit unknown.

The above compounds (idents) are reported at the client's request. They were identified and quantitated by the following procedure:

After identification and quantitation of the target compounds, the 20 most intense peaks remaining in the chromatogram are selected for examination. The spectra for these peaks are compared by computer with a National Bureau of Standards library containing 42,000 entries. A chemist trained in mass spectral interpretation then examines the results. Since at the outset these peaks are unknown, no standards are usually analyzed to obtain retention time or response factor data. Quantitation is based on a comparison of the area of the reconstructed ion chromatogram from the unknown peak and the nearest internal standard. This follows the EPA CLP protocol.

Table 2. Other Identified Compounds

Acurex Sample ID

Semivolatile Compounds	F1209 1725 ug/ext	F1211 1610 ug/ext	F1217 1128 ug/ext
2-Methylnapthalene	4900	3950	4260
Dibenzofuran	5900	4350	4400
Fatty acid esters	ND	ND	ND
Unknown PNA's	2000	4500	5900
Unknown hydrocarbons	ND	ND	ND
Other unknowns	6000	ND	3400

ND - Not detected among the major peaks examined, detection limit unknown.

The above compounds (idents) are reported at the client's request. They were identified and quantitated by the following procedure:

After identification and quantitation of the target compounds, the 20 most intense peaks remaining in the chromatogram are selected for examination. The spectra for these peaks are compared by computer with a National Bureau of Standards library containing 42,000 entries. A chemist trained in mass spectral interpretation then examines the results. Since at the outset these peaks are unknown, no standards are usually analyzed to obtain retention time or response factor data. Quantitation is based on a comparison of the area of the reconstructed ion chromatogram from the unknown peak and the nearest internal standard. This follows the EPA CLP protocol.

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Environmental Systems Division

Acurex

March 30, 1988
Acurex ID: 8802065
Client PO: 8281.14
Page 1 of 4

Attention: Larry Waterland

Subject: Analysis of 2 Extracts, Received 2/26/88.

Extracts were analyzed for semivolatile organic compounds according to U.S. EPA Method 8270 (Test Methods for Evaluating Solid Waste - SW846, 2nd Ed.,1982). Results are presented in Table 1. The method can be summarized as follows:

> Prior to injection into a Gas Chromatograph/Mass Spectrometer (GC/MS), the extract is combined with internal standards. The GC/MS is equipped with a fused silica capillary column and is set up for the analysis of semivolatile priority pollutants.

Identification and quantitation of other semivolatile compounds is presented in Table 2.

Qualitative identification of the priority pollutants is performed initially using the relative retention times and the relative abundance of three unique ions. The entire mass spectrum is checked before any final identifications are recorded. Quantitative analysis is performed by the internal standard method using a single characteristic ion and response factors obtained from a daily calibration standard. In the tables, an entry such as "<5" means that the compound was not found at a level above the laboratory's reporting limit.

If you should have any technical questions, please contact Susan M. Schrader at (415)961-5700.

Submitted by: Richard Scott
Richard Scott
Supervisor, Organic Chemistry

Approved by: Susan Schrader
Susan M. Schrader
Client Services Manager

These results were obtained by following standard laboratory procedures; the liability of Acurex Corporation shall not exceed the amount paid for this report. In no event shall Acurex be liable for special or consequential damages.

Table 1. Semivolatile Organic Results

Acurex Sample ID

8270 Compounds	Q0265 0830BBK ug/ext.	Q0129 1600TMBK ug/ext.
Phenol	<20	<20
Bis(2-chloroethyl)ether	<20	<20
2-Chlorophenol	<20	<20
1,3-Dichlorobenzene	<20	<20
1,4-Dichlorobenzene	<20	<20
1,2-Dichlorobenzene	<20	<20
Bis(2-chloroisopropyl)ether	<20	<20
N-Nitroso-di-n-propylamine	<20	<20
Hexachloroethane	<20	<20
Nitrobenzene	<20	<20
Isophorone	<20	<20
2-Nitrophenol	<20	<20
2,4-Dimethylphenol	<20	<20
Bis(2-chloroethoxy)methane	<20	<20
2,4-Dichlorophenol	<20	<20
1,2,4-Trichlorobenzene	<20	<20
Naphthalene	<20	<20
Hexachlorobutadiene	<20	<20
4-Chloro-3-methylphenol	<20	<20
Hexachlorocyclopentadiene	<20	<20
2,4,6-Trichlorophenol	<20	<20
2-Chloronaphthalene	<20	<20
Dimethyl phthalate	<20	<20
Acenaphthylene	<20	<20
Acenaphthene	<20	<20
2,4-Dinitrophenol	<100	<100
4-Nitrophenol	<100	<100
2,4-Dinitrotoluene	<20	<20
2,6-Dinitrotoluene	<20	<20
Diethyl phthalate	<20	<20
4-Chlorophenyl phenylether	<20	<20
Fluorene	<20	<20
4,6-Dinitro-2-methylphenol	<100	<100
N-Nitrosodiphenylamine	<20	<20
4-Bromophenyl phenylether	<20	<20
Hexachlorobenzene	<20	<20
Pentachlorophenol	<100	<100
Phenanthrene	<20	<20
Anthracene	<20	<20
Di-n-Butyl phthalate	<20	<20

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

8270 Compounds	Q0129 0830BBK ug/ext	Q0129 1600TMBK ug/ext
Fluoranthene	<20	<20
Pyrene	<20	<20
Butyl benzyl phthalate	<20	<20
3,3'-Dichlorobenzidine	<40	<40
Benzo(a)anthracene	<20	<20
Bis(2-ethylhexyl)phthalate	<20	<20
Chrysene	<20	<20
Di-n-octyl phthalate	<20	<20
Benzo(b)fluoranthene	<20	<20
Benzo(k)fluoranthene	<20	<20
Benzo(a)pyrene	<20	<20
Indeno(1,2,3-cd)pyrene	<20	<20
Dibenzo(a,h)anthracene	<20	<20
Benzo(g,h,i)perylene	<20	<20
alpha-BHC	<20	<20
beta-BHC	<20	<20
gamma-BHC	<20	<20
delta-BHC	<20	<20
Heptachlor	<20	<20
Aldrin	<20	<20
Heptachlor epoxide	<20	<20
Endosulfan I	<20	<20
Dieldrin	<20	<20
4,4'-DDE	<20	<20
Endrin	<20	<20
Endosulfan II	<20	<20
4,4'-DDD	<20	<20
Endrin aldehyde	<20	<20
Endosulfan sulfate	<20	<20
4,4'-DDT	<20	<20
PCBs	<20	<20
Date Analyzed	3/15/88	3/15/88
Date Extracted	Unknown	Unknown

Table 2. Other Identified Compounds

Acurex Sample ID

Semivolatile Compounds	Q0129 0830BBK % Recov	Q0129 1600TMBK % Recov
Octafluorobiphenyl*	12	72
9-Phenylanthracene*	17	41

No other compounds found

* - Extraction surrogates reported as percent recovery.

ND - Not detected among the major peaks examined, detection limit unknown.

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Environmental Systems Division

Acurex

April 7, 1988
Acurex ID: 8802032
Client PO: 8281.14
Page 1 of 28
Rev. 8/10/88

Attention: Larry Waterland

Subject: Analysis of 42 Extracts, Received 2/13/88.

Samples were analyzed for semivolatile organic compounds according to U.S. EPA Method 8270 (Test Methods for Evaluating Solid Waste - SW846, 2nd Ed.,1982). Results are presented in Table 1.

Identification and quantitation of other semivolatile compounds is presented in Table 2.

Qualitative identification of the priority pollutants is performed initially using the relative retention times and the relative abundance of three unique ions. The entire mass spectrum is checked before any final identifications are recorded. Quantitative analysis is performed by the internal standard method using a single characteristic ion and response factors obtained from a daily calibration standard. In the tables, an entry such as "<5" means that the compound was not found at a level above the laboratory's reporting limit. The reporting limit, which is based on EPA reporting levels, has been corrected for any sample dilution.

Prior to analysis, every sample is spiked with surrogate compounds as part of Acurex's Quality Control Program. These compounds simulate the behavior of compounds of interest and confirm that acceptable recoveries are being achieved on every sample. The results of surrogate recoveries are reported with the sample results.

If you should have any technical questions, please contact Robert DeRosier at (415)961-5700.

Submitted by: Richard Scott
Richard Scott
Acting GC Supervisor

Approved by:
Robert DeRosier
Client Services Manager

These results were obtained by following standard laboratory procedures; the liability of Acurex Corporation shall not exceed the amount paid for this report. In no event shall Acurex be liable for special or consequential damages.

485 Clyde Avenue, P.O. Box 7044, Mountain View, CA 94039 (415) 961-5700 Telex: 325961 FAX: (415) 964-5145

Table 1. Semivolatile Organic Results

Acurex Sample ID

8270 Compounds	S0114 1400 ug/ext	S0120 1535 ug/ext	S0127 1130 ug/ext	S0129 1155 ug/ext	E0114 1400 ug/ext
Phenol	<20	<20	<20	<20	<20
Bis(2-chloroethyl)ether	<20	<20	<20	<20	<20
2-Chlorophenol	<20	<20	<20	<20	<20
1,3-Dichlorobenzene	<20	<20	<20	<20	<20
1,4-Dichlorobenzene	<20	<20	<20	<20	<20
1,2-Dichlorobenzene	<20	<20	<20	<20	<20
Bis(2-chloroisopropyl)ether	<20	<20	<20	<20	<20
N-Nitroso-di-n-propylamine	<20	<20	<20	<20	<20
Hexachloroethane	<20	220	77	<20	<20
Nitrobenzene	<20	<20	<20	<20	<20
Isophorone	<20	<20	<20	<20	<20
2-Nitrophenol	<20	<20	<20	<20	<20
2,4-Dimethylphenol	<20	<20	<20	<20	<20
Bis(2-chloroethoxy)methane	<20	<20	<20	<20	<20
2,4-Dichlorophenol	<20	<20	<20	<20	<20
1,2,4-Trichlorobenzene	<20	<20	<20	<20	<20
Naphthalene	<20	20	<20	<20	<20
Hexachlorobutadiene	<20	<20	<20	<20	<20
4-Chloro-3-methylphenol	<20	<20	<20	<20	<20
Hexachlorocyclopentadiene	<20	<20	<20	<20	<20
2,4,6-Trichlorophenol	<20	<20	<20	<20	<20
2-Chloronaphthalene	<20	<20	<20	<20	<20
Dimethyl phthalate	<20	<20	<20	<20	<20
Acenaphthylene	<20	<20	<20	<20	<20
Acenaphthene	<20	<20	<20	<20	<20
2,4-Dinitrophenol	<100	<100	<100	<100	<100
4-Nitrophenol	<100	<100	<100	<100	<100
2,4-Dinitrotoluene	<20	<20	<20	<20	<20
2,6-Dinitrotoluene	<20	<20	<20	<20	<20
Diethyl phthalate	<20	<20	<20	<20	<20
4-Chlorophenyl phenylether	<20	<20	<20	<20	<20
Fluorene	<20	<20	<20	<20	<20
4,6-Dinitro-2-methylphenol	<100	<100	<100	<100	<100
N-Nitrosodiphenylamine	<20	<20	<20	<20	<20
4-Bromophenyl phenylether	<20	<20	<20	<20	<20
Hexachlorobenzene	<20	<20	<20	<20	<20
Pentachlorophenol	<100	<100	<100	<100	<100
Phenanthrene	<20	<20	<20	<20	<20
Anthracene	<20	<20	<20	<20	<20
Di-n-Butyl phthalate	<20	<20	<20	<20	<20

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

8270 Compounds	S0114 1400	S0120 1535	S0127 1130	S0129 1155	E0114 1400
	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Fluoranthene	<20	<20	<20	<20	<20
Pyrene	<20	<20	<20	<20	<20
Butyl benzyl phthalate	<20	27	<20	<20	37
3,3'-Dichlorobenzidine	<40	<40	<40	<40	<40
Benzo(a)anthracene	<20	<20	<20	<20	<20
Bis(2-ethylhexyl)phthalate	96	290	<20	2000	910
Chrysene	<20	<20	<20	<20	<20
Di-n-octyl phthalate	<20	36	28	<20	30
Benzo(b)fluoranthene	<20	<20	<20	<20	<20
Benzo(k)fluoranthene	<20	<20	<20	<20	<20
Benzo(a)pyrene	<20	<20	<20	<20	<20
Indeno(1,2,3-cd)pyrene	<20	<20	<20	<20	<20
Dibenzo(a,h)anthracene	<20	<20	<20	<20	<20
Benzo(g,h,i)perylene	<20	<20	<20	<20	<20
alpha-BHC	<20	<20	<20	<20	<20
beta-BHC	<20	<20	<20	<20	<20
gamma-BHC	<20	<20	<20	<20	<20
delta-BHC	<20	<20	<20	<20	<20
Heptachlor	<20	<20	<20	<20	<20
Aldrin	<20	<20	<20	<20	<20
Heptachlor epoxide	<20	<20	<20	<20	<20
Endosulfan I	<20	<20	<20	<20	<20
Dieldrin	<20	<20	<20	<20	<20
4,4'-DDE	<20	<20	<20	<20	<20
Endrin	<20	<20	<20	<20	<20
Endosulfan II	<20	<20	<20	<20	<20
4,4'-DDD	<20	<20	<20	<20	<20
Endrin aldehyde	<20	<20	<20	<20	<20
Endosulfan sulfate	<20	<20	<20	<20	<20
4,4'-DDT	<20	<20	<20	<20	<20
PCBs	<20	<20	<20	<20	<20
Date Analyzed	3/16/88	2/28/88	2/29/88	3/1/88	3/16/88

Surrogates	Percent Recovery (%)				
Octafluorobiphenyl	1.4	106	81	81	71
9-Phenylanthracene	1.5	101	69	77	66

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

8270 Compounds	E0120 1535T1	E0120 1535T2	E0121 1230T1	E0121 1230T2	E0127 1130
	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Phenol	<20	<20	<20	<20	<20
Bis(2-chloroethyl)ether	<20	<20	<20	<20	<20
2-Chlorophenol	<20	<20	<20	<20	<20
1,3-Dichlorobenzene	<20	<20	<20	<20	<20
1,4-Dichlorobenzene	<20	<20	<20	<20	<20
1,2-Dichlorobenzene	<20	<20	<20	<20	<20
Bis(2-chloroisopropyl)ether	<20	<20	<20	<20	<20
N-Nitroso-di-n-propylamine	<20	<20	<20	<20	<20
Hexachloroethane	31	110	<20	<20	25
Nitrobenzene	<20	<20	<20	<20	<20
Isophorone	<20	<20	<20	<20	<20
2-Nitrophenol	<20	<20	<20	<20	<20
2,4-Dimethylphenol	<20	<20	<20	<20	<20
Bis(2-chloroethoxy)methane	<20	<20	<20	<20	<20
2,4-Dichlorophenol	<20	<20	29	<20	<20
1,2,4-Trichlorobenzene	<20	<20	<20	<20	<20
Naphthalene	<20	<20	<20	<20	<20
Hexachlorobutadiene	<20	<20	<20	<20	<20
4-Chloro-3-methylphenol	<20	<20	<20	<20	<20
Hexachlorocyclopentadiene	<20	<20	<20	<20	<20
2,4,6-Trichlorophenol	<20	<20	<20	<20	<20
2-Chloronaphthalene	<20	<20	<20	<20	<20
Dimethyl phthalate	<20	<20	<20	<20	<20
Acenaphthylene	<20	<20	<20	<20	<20
Acenaphthene	<20	<20	<20	<20	<20
2,4-Dinitrophenol	<100	<100	<100	<100	<100
4-Nitrophenol	<100	<100	<100	<100	<100
2,4-Dinitrotoluene	<20	<20	<20	<20	<20
2,6-Dinitrotoluene	<20	<20	<20	<20	<20
Diethyl phthalate	<20	<20	<20	<20	<20
4-Chlorophenyl phenylether	<20	<20	<20	<20	<20
Fluorene	<20	<20	<20	<20	<20
4,6-Dinitro-2-methylphenol	<100	<100	<100	<100	<100
N-Nitrosodiphenylamine	<20	<20	<20	<20	<20
4-Bromophenyl phenylether	<20	<20	<20	<20	<20
Hexachlorobenzene	<20	<20	<20	<20	<20
Pentachlorophenol	<100	<100	<100	<100	<100
Phenanthrene	<20	<20	<20	<20	<20
Anthracene	<20	<20	<20	<20	<20
Di-n-Butyl phthalate	<20	<20	<20	<20	<20

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

8270 Compounds	E0120 1535T1 ug/ext	E0120 1535T2 ug/ext	E0121 1230T1 ug/ext	E0121 1230T2 ug/ext	E0127 1130 ug/ext
Fluoranthene	<20	<20	<20	<20	<20
Pyrene	<20	<20	<20	<20	<20
Butyl benzyl phthalate	<20	<20	<20	<20	<20
3,3'-Dichlorobenzidine	<40	<40	<40	<40	<40
Benzo(a)anthracene	<20	<20	<20	<20	<20
Bis(2-ethylhexyl)phthalate	330	39	120	290	780
Chrysene	<20	<20	<20	<20	<20
Di-n-octyl phthalate	22	<20	31	39	<20
Benzo(b)fluoranthene	<20	<20	<20	<20	<20
Benzo(k)fluoranthene	<20	<20	<20	<20	<20
Benzo(a)pyrene	<20	<20	<20	<20	<20
Indeno(1,2,3-cd)pyrene	<20	<20	<20	<20	<20
Dibenzo(a,h)anthracene	<20	<20	<20	<20	<20
Benzo(g,h,i)perylene	<20	<20	<20	<20	<20
alpha-BHC	<20	<20	<20	<20	<20
beta-BHC	<20	<20	<20	<20	<20
gamma-BHC	<20	<20	<20	<20	<20
delta-BHC	<20	<20	<20	<20	<20
Heptachlor	<20	<20	<20	<20	<20
Aldrin	<20	<20	<20	<20	<20
Heptachlor epoxide	<20	<20	<20	<20	<20
Endosulfan I	<20	<20	<20	<20	<20
Dieldrin	<20	<20	<20	<20	<20
4,4'-DDE	<20	<20	<20	<20	<20
Endrin	<20	<20	<20	<20	<20
Endosulfan II	<20	<20	<20	<20	<20
4,4'-DDD	<20	<20	<20	<20	<20
Endrin aldehyde	<20	<20	<20	<20	<20
Endosulfan sulfate	<20	<20	<20	<20	<20
4,4'-DDT	<20	<20	<20	<20	<20
PCBs	<20	<20	<20	<20	<20
Date Analyzed	2/28/88	2/28/88	2/28/88	2/28/88	2/29/88

Surrogates	Percent Recovery (%)				
Octafluorobiphenyl	72	82	80	71	86
9-Phenylanthracene	75	81	83	72	81

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

	E0129 1155	B0114 1800	B0120 2100	B0121 1220	B0127 1600
8270 Compounds	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Phenol	<20	<20	<20	<20	<20
Bis(2-chloroethyl)ether	<20	<20	<20	<20	<20
2-Chlorophenol	<20	<20	<20	<20	<20
1,3-Dichlorobenzene	<20	<20	<20	<20	<20
1,4-Dichlorobenzene	<20	<20	<20	<20	<20
1,2-Dichlorobenzene	<20	<20	<20	<20	<20
Bis(2-chloroisopropyl)ether	<20	<20	<20	<20	<20
N-Nitroso-di-n-propylamine	<20	<20	<20	<20	<20
Hexachloroethane	<20	<20	<20	<20	<20
Nitrobenzene	<20	<20	<20	<20	<20
Isophorone	<20	<20	<20	<20	<20
2-Nitrophenol	<20	<20	<20	<20	<20
2,4-Dimethylphenol	<20	<20	<20	<20	<20
Bis(2-chloroethoxy)methane	<20	<20	<20	<20	<20
2,4-Dichlorophenol	<20	<20	<20	<20	<20
1,2,4-Trichlorobenzene	<20	<20	<20	<20	<20
Naphthalene	<20	<20	<20	<20	<20
Hexachlorobutadiene	<20	<20	<20	<20	<20
4-Chloro-3-methylphenol	<20	<20	<20	<20	<20
Hexachlorocyclopentadiene	<20	<20	<20	<20	<20
2,4,6-Trichlorophenol	<20	<20	<20	<20	<20
2-Chloronaphthalene	<20	<20	<20	<20	<20
Dimethyl phthalate	<20	<20	<20	<20	<20
Acenaphthylene	<20	<20	<20	<20	<20
Acenaphthene	<20	<20	<20	<20	<20
2,4-Dinitrophenol	<100	<100	<100	<100	<100
4-Nitrophenol	<100	<100	<100	<100	<100
2,4-Dinitrotoluene	<20	<20	<20	<20	<20
2,6-Dinitrotoluene	<20	<20	<20	<20	<20
Diethyl phthalate	<20	<20	<20	<20	<20
4-Chlorophenyl phenylether	<20	<20	<20	<20	<20
Fluorene	<20	<20	<20	<20	<20
4,6-Dinitro-2-methylphenol	<100	<100	<100	<100	<100
N-Nitrosodiphenylamine	<20	<20	<20	<20	<20
4-Bromophenyl phenylether	<20	<20	<20	<20	<20
Hexachlorobenzene	<20	<20	<20	<20	<20
Pentachlorophenol	<100	<100	<100	<100	<100
Phenanthrene	<20	<20	<20	<20	<20
Anthracene	<20	<20	<20	<20	<20
Di-n-Butyl phthalate	<20	<20	<20	<20	<20

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

8270 Compounds	E0129 1155 ug/ext	B0114 1800 ug/ext	B0120 2100 ug/ext	B0121 1220 ug/ext	B0127 1600 ug/ext
Fluoranthene	<20	<20	<20	<20	<20
Pyrene	<20	<20	<20	<20	<20
Butyl benzyl phthalate	<20	<20	<20	<20	<20
3,3'-Dichlorobenzidine	<40	<40	<40	<40	<40
Benzo(a)anthracene	<20	<20	<20	<20	<20
Bis(2-ethylhexyl)phthalate	<20	<20	<20	<20	<20
Chrysene	<20	<20	<20	<20	<20
Di-n-octyl phthalate	<20	<20	<20	<20	<20
Benzo(b)fluoranthene	<20	<20	<20	<20	<20
Benzo(k)fluoranthene	<20	<20	<20	<20	<20
Benzo(a)pyrene	<20	<20	<20	<20	<20
Indeno(1,2,3-cd)pyrene	<20	<20	<20	<20	<20
Dibenzo(a,h)anthracene	<20	<20	<20	<20	<20
Benzo(g,h,i)perylene	<20	<20	<20	<20	<20
alpha-BHC	<20	<20	<20	<20	<20
beta-BHC	<20	<20	<20	<20	<20
gamma-BHC	<20	<20	<20	<20	<20
delta-BHC	<20	<20	<20	<20	<20
Heptachlor	<20	<20	<20	<20	<20
Aldrin	<20	<20	<20	<20	<20
Heptachlor epoxide	<20	<20	<20	<20	<20
Endosulfan I	<20	<20	<20	<20	<20
Dieldrin	<20	<20	<20	<20	<20
4,4'-DDE	<20	<20	<20	<20	<20
Endrin	<20	<20	<20	<20	<20
Endosulfan II	<20	<20	<20	<20	<20
4,4'-DDD	<20	<20	<20	<20	<20
Endrin aldehyde	<20	<20	<20	<20	<20
Endosulfan sulfate	<20	<20	<20	<20	<20
4,4'-DDT	<20	<20	<20	<20	<20
PCBs	<20	<20	<20	<20	<20
Date Analyzed	3/1/88	3/16/88	2/28/88	2/28/88	2/29/88

Surrogates	Percent Recovery (%)				
Octafluorobiphenyl	75	15	13	14	17
9-Phenylanthracene	77	60	57	76	73

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

	B0129 1430	T0114 1345	T0120 1535	T0121 1200	T0127 1130
8270 Compounds	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Phenol	<20	<20	<20	<20	<20
Bis(2-chloroethyl)ether	<20	<20	<20	<20	<20
2-Chlorophenol	<20	<20	<20	<20	<20
1,3-Dichlorobenzene	<20	<20	<20	<20	<20
1,4-Dichlorobenzene	<20	<20	<20	<20	<20
1,2-Dichlorobenzene	<20	<20	<20	<20	<20
Bis(2-chloroisopropyl)ether	<20	<20	<20	<20	<20
N-Nitroso-di-n-propylamine	<20	<20	<20	<20	<20
Hexachloroethane	<20	<20	<20	<20	<20
Nitrobenzene	<20	<20	<20	<20	<20
Isophorone	<20	<20	<20	<20	<20
2-Nitrophenol	<20	<20	<20	<20	<20
2,4-Dimethylphenol	<20	<20	<20	<20	<20
Bis(2-chloroethoxy)methane	<20	<20	<20	<20	<20
2,4-Dichlorophenol	<20	<20	<20	<20	<20
1,2,4-Trichlorobenzene	<20	<20	<20	<20	<20
Naphthalene	<20	<20	<20	<20	<20
Hexachlorobutadiene	<20	<20	<20	<20	<20
4-Chloro-3-methylphenol	<20	<20	<20	<20	<20
Hexachlorocyclopentadiene	<20	<20	<20	<20	<20
2,4,6-Trichlorophenol	<20	<20	<20	<20	<20
2-Chloronaphthalene	<20	<20	<20	<20	<20
Dimethyl phthalate	<20	<20	<20	<20	<20
Acenaphthylene	<20	<20	<20	<20	<20
Acenaphthene	<20	<20	<20	<20	<20
2,4-Dinitrophenol	<100	<100	<100	<100	<100
4-Nitrophenol	<100	<100	<100	<100	<100
2,4-Dinitrotoluene	<20	<20	<20	<20	<20
2,6-Dinitrotoluene	<20	<20	<20	<20	<20
Diethyl phthalate	<20	<20	<20	<20	<20
4-Chlorophenyl phenylether	<20	<20	<20	<20	<20
Fluorene	<20	<20	<20	<20	<20
4,6-Dinitro-2-methylphenol	<100	<100	<100	<100	<100
N-Nitrosodiphenylamine	<20	<20	<20	<20	<20
4-Bromophenyl phenylether	<20	<20	<20	<20	<20
Hexachlorobenzene	<20	<20	<20	<20	<20
Pentachlorophenol	<100	<100	<100	<100	<100
Phenanthrene	<20	<20	<20	<20	<20
Anthracene	<20	<20	<20	<20	<20
Di-n-Butyl phthalate	<20	<20	<20	<20	<20

Table 1. Semivolatile Organic Results (Continued)

	Acurex Sample ID				
	B0129 1430	T0114 1345	T0120 1535	T0121 1200	T0127 1130
8270 Compounds	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Fluoranthene	<20	<20	<20	<20	<20
Pyrene	<20	<20	<20	<20	<20
Butyl benzyl phthalate	<20	<20	<20	<20	<20
3,3'-Dichlorobenzidine	<40	<40	<40	<40	<40
Benzo(a)anthracene	<20	<20	<20	<20	<20
Bis(2-ethylhexyl)phthalate	<20	43	20	<20	<20
Chrysene	<20	<20	<20	<20	<20
Di-n-octyl phthalate	<20	<20	<20	<20	<20
Benzo(b)fluoranthene	<20	<20	<20	<20	<20
Benzo(k)fluoranthene	<20	<20	<20	<20	<20
Benzo(a)pyrene	<20	<20	<20	<20	<20
Indeno(1,2,3-cd)pyrene	<20	<20	<20	<20	<20
Dibenzo(a,h)anthracene	<20	<20	<20	<20	<20
Benzo(g,h,i)perylene	<20	<20	<20	<20	<20
alpha-BHC	<20	<20	<20	<20	<20
beta-BHC	<20	<20	<20	<20	<20
gamma-BHC	<20	<20	<20	<20	<20
delta-BHC	<20	<20	<20	<20	<20
Heptachlor	<20	<20	<20	<20	<20
Aldrin	<20	<20	<20	<20	<20
Heptachlor epoxide	<20	<20	<20	<20	<20
Endosulfan I	<20	<20	<20	<20	<20
Dieldrin	<20	<20	<20	<20	<20
4,4'-DDE	<20	<20	<20	<20	<20
Endrin	<20	<20	<20	<20	<20
Endosulfan II	<20	<20	<20	<20	<20
4,4'-DDD	<20	<20	<20	<20	<20
Endrin aldehyde	<20	<20	<20	<20	<20
Endosulfan sulfate	<20	<20	<20	<20	<20
4,4'-DDT	<20	<20	<20	<20	<20
PCBs	<20	<20	<20	<20	<20
Date Analyzed	3/1/88	3/16/88	2/28/88	2/28/88	2/29/88

Surrogates	Percent Recovery (%)				
Octafluorobiphenyl	1.4	44	50	54	66
9-Phenylanthracene	15	70	5.7	15	92

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

	T0129 1155	Q0114 1028FSK	Q0114 1020FBK	Q0120 0841FBK	Q0120 0848FSK
8270 Compounds	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Phenol	<20	<20	<20	<20	<20
Bis(2-chloroethyl)ether	<20	<20	<20	<20	<20
2-Chlorophenol	<20	<20	<20	<20	<20
1,3-Dichlorobenzene	<20	<20	<20	<20	<20
1,4-Dichlorobenzene	<20	<20	<20	<20	<20
1,2-Dichlorobenzene	<20	<20	<20	<20	<20
Bis(2-chloroisopropyl)ether	<20	<20	<20	<20	<20
N-Nitroso-di-n-propylamine	<20	<20	<20	<20	<20
Hexachloroethane	<20	<20	<20	<20	<20
Nitrobenzene	<20	<20	<20	<20	<20
Isophorone	<20	<20	<20	<20	<20
2-Nitrophenol	<20	<20	<20	<20	<20
2,4-Dimethylphenol	<20	<20	<20	<20	<20
Bis(2-chloroethoxy)methane	<20	<20	<20	<20	<20
2,4-Dichlorophenol	<20	<20	<20	<20	<20
1,2,4-Trichlorobenzene	<20	<20	<20	<20	<20
Naphthalene	<20	32	<20	33	<20
Hexachlorobutadiene	<20	<20	<20	<20	<20
4-Chloro-3-methylphenol	<20	<20	<20	<20	<20
Hexachlorocyclopentadiene	<20	<20	<20	<20	<20
2,4,6-Trichlorophenol	<20	<20	<20	<20	<20
2-Chloronaphthalene	<20	<20	<20	<20	<20
Dimethyl phthalate	<20	<20	<20	<20	<20
Acenaphthylene	<20	53	<20	51	<20
Acenaphthene	<20	<20	<20	<20	<20
2,4-Dinitrophenol	<100	<100	<100	<100	<100
4-Nitrophenol	<100	<100	<100	<100	<100
2,4-Dinitrotoluene	<20	<20	<20	<20	<20
2,6-Dinitrotoluene	<20	<20	<20	<20	<20
Diethyl phthalate	<20	<20	<20	<20	<20
4-Chlorophenyl phenylether	<20	<20	<20	<20	<20
Fluorene	<20	39	<20	35	<20
4,6-Dinitro-2-methylphenol	<100	<100	<100	<100	<100
N-Nitrosodiphenylamine	<20	<20	<20	<20	<20
4-Bromophenyl phenylether	<20	<20	<20	<20	<20
Hexachlorobenzene	<20	<20	<20	<20	<20
Pentachlorophenol	<100	<100	<100	<100	<100
Phenanthrene	<20	45	<20	34	<20
Anthracene	<20	47	<20	40	<20
Di-n-Butyl phthalate	<20	<20	<20	<20	<20

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

8270 Compounds	T0129 1155 ug/ext	Q0114 1028FSK ug/ext	Q0114 1020FBK ug/ext	Q0120 0841FBK ug/ext	Q0120 0848FSK ug/ext
Fluoranthene	<20	35	<20	29	<20
Pyrene	<20	<20	<20	<20	<20
Butyl benzyl phthalate	<20	<20	<20	<20	<20
3,3'-Dichlorobenzidine	<40	<40	<40	<40	<40
Benzo(a)anthracene	<20	<20	<20	<20	<20
Bis(2-ethylhexyl)phthalate	<20	140	140	27	59
Chrysene	<20	<20	<20	<20	<20
Di-n-octyl phthalate	<20	<20	<20	<20	<20
Benzo(b)fluoranthene	<20	<20	<20	<20	<20
Benzo(k)fluoranthene	<20	<20	<20	<20	<20
Benzo(a)pyrene	<20	<20	<20	<20	<20
Indeno(1,2,3-cd)pyrene	<20	<20	<20	<20	<20
Dibenzo(a,h)anthracene	<20	<20	<20	<20	<20
Benzo(g,h,i)perylene	<20	<20	<20	<20	<20
alpha-BHC	<20	<20	<20	<20	<20
beta-BHC	<20	<20	<20	<20	<20
gamma-BHC	<20	<20	<20	<20	<20
delta-BHC	<20	<20	<20	<20	<20
Heptachlor	<20	<20	<20	<20	<20
Aldrin	<20	<20	<20	<20	<20
Heptachlor epoxide	<20	<20	<20	<20	<20
Endosulfan I	<20	<20	<20	<20	<20
Dieldrin	<20	<20	<20	<20	<20
4,4'-DDE	<20	<20	<20	<20	<20
Endrin	<20	<20	<20	<20	<20
Endosulfan II	<20	<20	<20	<20	<20
4,4'-DDD	<20	<20	<20	<20	<20
Endrin aldehyde	<20	<20	<20	<20	<20
Endosulfan sulfate	<20	<20	<20	<20	<20
4,4'-DDT	<20	<20	<20	<20	<20
PCBs	<20	<20	<20	<20	<20
Date Analyzed	3/1/88	3/16/88	3/16/88	2/29/88	2/28/88

Surrogates	Percent Recovery (%)				
Octafluorobiphenyl	64	63	60	72	63
9-Phenylanthracene	97	69	78	75	90

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

	Q0121 0836FBK	Q0127 0830FSK	Q0127 0829FBK	Q0129 0730FSK	Q0129 0731FBK
8270 Compounds	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Phenol	<20	<20	<20	<20	<20
Bis(2-chloroethyl)ether	<20	<20	<20	<20	<20
2-Chlorophenol	<20	<20	<20	<20	<20
1,3-Dichlorobenzene	<20	<20	<20	<20	<20
1,4-Dichlorobenzene	<20	<20	<20	<20	<20
1,2-Dichlorobenzene	<20	<20	<20	<20	<20
Bis(2-chloroisopropyl)ether	<20	<20	<20	<20	<20
N-Nitroso-di-n-propylamine	<20	<20	<20	<20	<20
Hexachloroethane	<20	<20	<20	<20	<20
Nitrobenzene	<20	<20	<20	<20	<20
Isophorone	<20	<20	<20	<20	<20
2-Nitrophenol	<20	<20	<20	<20	<20
2,4-Dimethylphenol	<20	<20	<20	<20	<20
Bis(2-chloroethoxy)methane	<20	<20	<20	<20	<20
2,4-Dichlorophenol	<20	<20	<20	<20	<20
1,2,4-Trichlorobenzene	<20	<20	<20	<20	<20
Naphthalene	<20	34	<20	39	<20
Hexachlorobutadiene	<20	<20	<20	<20	<20
4-Chloro-3-methylphenol	<20	<20	<20	<20	<20
Hexachlorocyclopentadiene	<20	<20	<20	<20	<20
2,4,6-Trichlorophenol	<20	<20	<20	<20	<20
2-Chloronaphthalene	<20	<20	<20	<20	<20
Dimethyl phthalate	<20	<20	<20	<20	<20
Acenaphthylene	<20	57	<20	61	<20
Acenaphthene	<20	<20	<20	<20	<20
2,4-Dinitrophenol	<100	<100	<100	<100	<100
4-Nitrophenol	<100	<100	<100	<100	<100
2,4-Dinitrotoluene	<20	<20	<20	<20	<20
2,6-Dinitrotoluene	<20	<20	<20	<20	<20
Diethyl phthalate	<20	<20	<20	<20	<20
4-Chlorophenyl phenylether	<20	<20	<20	<20	<20
Fluorene	<20	40	<20	46	<20
4,6-Dinitro-2-methylphenol	<100	<100	<100	<100	<100
N-Nitrosodiphenylamine	<20	<20	<20	<20	<20
4-Bromophenyl phenylether	<20	<20	<20	<20	<20
Hexachlorobenzene	<20	<20	<20	<20	<20
Pentachlorophenol	<100	<100	<100	<100	<100
Phenanthrene	<20	41	<20	47	<20
Anthracene	<20	46	<20	50	<20
Di-n-Butyl phthalate	<20	<20	<20	<20	<20

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

8270 Compounds	Q0121 0836FBK ug/ext	Q0127 0830FSK ug/ext	Q0127 0829FBK ug/ext	Q0129 0730FSK ug/ext	Q0129 0731FBK ug/ext
Fluoranthene	<20	37	<20	33	<20
Pyrene	<20	<20	<20	<20	<20
Butyl benzyl phthalate	<20	<20	<20	<20	<20
3,3'-Dichlorobenzidine	<40	<40	<40	<40	<40
Benzo(a)anthracene	<20	<20	<20	<20	<20
Bis(2-ethylhexyl)phthalate	<20	<20	54	120	<20
Chrysene	<20	<20	<20	<20	<20
Di-n-octyl phthalate	<20	<20	<20	<20	<20
Benzo(b)fluoranthene	<20	<20	<20	<20	<20
Benzo(k)fluoranthene	<20	<20	<20	<20	<20
Benzo(a)pyrene	<20	<20	<20	<20	<20
Indeno(1,2,3-cd)pyrene	<20	<20	<20	<20	<20
Dibenzo(a,h)anthracene	<20	<20	<20	<20	<20
Benzo(g,h,i)perylene	<20	<20	<20	<20	<20
alpha-BHC	<20	<20	<20	<20	<20
beta-BHC	<20	<20	<20	<20	<20
gamma-BHC	<20	<20	<20	<20	<20
delta-BHC	<20	<20	<20	<20	<20
Heptachlor	<20	<20	<20	<20	<20
Aldrin	<20	<20	<20	<20	<20
Heptachlor epoxide	<20	<20	<20	<20	<20
Endosulfan I	<20	<20	<20	<20	<20
Dieldrin	<20	<20	<20	<20	<20
4,4'-DDE	<20	<20	<20	<20	<20
Endrin	<20	<20	<20	<20	<20
Endosulfan II	<20	<20	<20	<20	<20
4,4'-DDD	<20	<20	<20	<20	<20
Endrin aldehyde	<20	<20	<20	<20	<20
Endosulfan sulfate	<20	<20	<20	<20	<20
4,4'-DDT	<20	<20	<20	<20	<20
PCBs	<20	<20	<20	<20	<20
Date Analyzed	2/29/88	2/29/88	3/1/88	3/1/88	3/1/88

Surrogates	Percent Recovery (%)				
Octafluorobiphenyl	68	69	67	72	14
9-Phenylanthracene	96	75	86	68	17

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

8270 Compounds	Q0127 1130TSK ug/ext	Q0120 1535TSK ug/ext	Q0120 2100BSK ug/ext	Q0127 1600BSK ug/ext	F0114 1545 ug/ext
Phenol	<20	<20	<20	<20	<5000
Bis(2-chloroethyl)ether	<20	<20	<20	<20	<5000
2-Chlorophenol	<20	<20	<20	<20	<5000
1,3-Dichlorobenzene	<20	<20	<20	<20	<5000
1,4-Dichlorobenzene	<20	<20	<20	<20	<5000
1,2-Dichlorobenzene	<20	<20	<20	<20	<5000
Bis(2-chloroisopropyl)ether	<20	<20	<20	<20	<5000
N-Nitroso-di-n-propylamine	<20	<20	<20	<20	<5000
Hexachloroethane	<20	<20	<20	<20	<5000
Nitrobenzene	<20	<20	<20	<20	<5000
Isophorone	<20	<20	<20	<20	<5000
2-Nitrophenol	<20	<20	<20	<20	<5000
2,4-Dimethylphenol	<20	<20	<20	<20	<5000
Bis(2-chloroethoxy)methane	<20	<20	<20	<20	<5000
2,4-Dichlorophenol	<20	<20	<20	<20	<5000
1,2,4-Trichlorobenzene	<20	<20	<20	<20	<5000
Naphthalene	36	<20	<20	<20	68000
Hexachlorobutadiene	<20	<20	<20	<20	<5000
4-Chloro-3-methylphenol	<20	<20	<20	<20	<5000
Hexachlorocyclopentadiene	<20	<20	<20	<20	<5000
2,4,6-Trichlorophenol	<20	<20	<20	<20	<5000
2-Chloronaphthalene	<20	<20	<20	<20	<5000
Dimethyl phthalate	<20	<20	<20	<20	<5000
Acenaphthylene	29	<20	34	35	16000
Acenaphthene	<20	<20	<20	<20	<5000
2,4-Dinitrophenol	<100	<100	<100	<100	<25000
4-Nitrophenol	<100	<100	<100	<100	<25000
2,4-Dinitrotoluene	<20	<20	<20	<20	<5000
2,6-Dinitrotoluene	<20	<20	<20	<20	<5000
Diethyl phthalate	<20	<20	<20	<20	<5000
4-Chlorophenyl phenylether	<20	<20	<20	<20	<5000
Fluorene	38	<20	24	22	7900
4,6-Dinitro-2-methylphenol	<100	<100	<100	<100	<25000
N-Nitrosodiphenylamine	<20	<20	<20	<20	<5000
4-Bromophenyl phenylether	<20	<20	<20	<20	<5000
Hexachlorobenzene	<20	<20	<20	<20	<5000
Pentachlorophenol	<100	<100	<100	<100	<25000
Phenanthrene	41	<20	26	25	28000
Anthracene	36	<20	35	34	8500
Di-n-Butyl phthalate	<20	<20	<20	<20	<5000

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

8270 Compounds	Q0127 1130TSK ug/ext	Q0120 1535TSK ug/ext	Q0120 2100BSK ug/ext	Q0127 1600BSK ug/ext	F0114 1545 ug/ext
Fluoranthene	41	<20	24	21	13000
Pyrene	<20	<20	<20	<20	12000
Butyl benzyl phthalate	<20	<20	<20	<20	<5000
3,3'-Dichlorobenzidine	<40	<40	<40	<40	<10000
Benzo(a)anthracene	<20	<20	<20	<20	5800
Bis(2-ethylhexyl)phthalate	<20	<20	<20	26	<5000
Chrysene	<20	<20	<20	<20	6100
Di-n-octyl phthalate	<20	<20	<20	<20	<5000
Benzo(b)fluoranthene	<20	<20	<20	<20	6600
Benzo(k)fluoranthene	<20	<20	<20	<20	<5000
Benzo(a)pyrene	<20	<20	<20	<20	<5000
Indeno(1,2,3-cd)pyrene	<20	<20	<20	<20	22000
Dibenzo(a,h)anthracene	<20	<20	<20	<20	<5000
Benzo(g,h,i)perylene	<20	<20	<20	<20	<5000
alpha-BHC	<20	<20	<20	<20	<5000
beta-BHC	<20	<20	<20	<20	<5000
gamma-BHC	<20	<20	<20	<20	<5000
delta-BHC	<20	<20	<20	<20	<5000
Heptachlor	<20	<20	<20	<20	<5000
Aldrin	<20	<20	<20	<20	<5000
Heptachlor epoxide	<20	<20	<20	<20	<5000
Endosulfan I	<20	<20	<20	<20	<5000
Dieldrin	<20	<20	<20	<20	<5000
4,4'-DDE	<20	<20	<20	<20	<5000
Endrin	<20	<20	<20	<20	<5000
Endosulfan II	<20	<20	<20	<20	<5000
4,4'-DDD	<20	<20	<20	<20	<5000
Endrin aldehyde	<20	<20	<20	<20	<5000
Endosulfan sulfate	<20	<20	<20	<20	<5000
4,4'-DDT	<20	<20	<20	<20	<5000
PCBs	<20	<20	<20	<20	<5000
Date Analyzed	2/29/88	2/29/88	2/29/88	3/1/88	3/20/88

Surrogates	Percent Recovery (%)				
Octafluorobiphenyl	70	56	12	14	103
9-Phenylanthracene	78	2.6	55	47	91

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

8270 Compounds	F0120 2110 ug/ext	F0121 1228 ug/ext	F0127 1130 ug/ext	F0129 1430 ug/ext	Q0114 1545FMSK ug/ext
Phenol	<5000	<10000	<330	<330	<10000
Bis(2-chloroethyl)ether	<5000	<10000	<330	<330	<10000
2-Chlorophenol	<5000	<10000	<330	<330	<10000
1,3-Dichlorobenzene	<5000	<10000	<330	<330	<10000
1,4-Dichlorobenzene	<5000	<10000	<330	<330	<10000
1,2-Dichlorobenzene	<5000	<10000	<330	<330	<10000
Bis(2-chloroisopropyl)ether	<5000	<10000	<330	<330	<10000
N-Nitroso-di-n-propylamine	<5000	<10000	<330	<330	<10000
Hexachloroethane	<5000	<10000	3500	4000	<10000
Nitrobenzene	<5000	<10000	<330	<330	<10000
Isophorone	<5000	<10000	<330	<330	<10000
2-Nitrophenol	<5000	<10000	<330	<330	<10000
2,4-Dimethylphenol	<5000	<10000	<330	<330	<10000
Bis(2-chloroethoxy)methane	<5000	<10000	<330	<330	<10000
2,4-Dichlorophenol	<5000	<10000	<330	<330	<10000
1,2,4-Trichlorobenzene	<5000	<10000	<330	<330	<10000
Naphthalene	63000	100000	<330	<330	110000
Hexachlorobutadiene	<5000	<10000	<330	<330	<10000
4-Chloro-3-methylphenol	<5000	<10000	<330	<330	<10000
Hexachlorocyclopentadiene	<5000	<10000	<330	<330	<10000
2,4,6-Trichlorophenol	<5000	<10000	<330	<330	<10000
2-Chloronaphthalene	<5000	<10000	<330	<330	<10000
Dimethyl phthalate	<5000	<10000	<330	<330	<10000
Acenaphthylene	16000	24000	<330	<330	51000
Acenaphthene	<5000	<10000	<330	<330	<10000
2,4-Dinitrophenol	<25000	<50000	<1700	<1700	<50000
4-Nitrophenol	<25000	<50000	<1700	<1700	<50000
2,4-Dinitrotoluene	<5000	<10000	<330	<330	<10000
2,6-Dinitrotoluene	<5000	<10000	<330	<330	<10000
Diethyl phthalate	<5000	<10000	<330	<330	<10000
4-Chlorophenyl phenylether	<5000	<10000	<330	<330	<10000
Fluorene	7700	12000	<330	<330	42000
4,6-Dinitro-2-methylphenol	<25000	<50000	<1700	<1700	<50000
N-Nitrosodiphenylamine	<5000	<10000	<330	<330	<10000
4-Bromophenyl phenylether	<5000	<10000	<330	<330	<10000
Hexachlorobenzene	<5000	<10000	<330	<330	<10000
Pentachlorophenol	<25000	<50000	<1700	<1700	<50000
Phenanthrene	28000	43000	<330	<330	55000
Anthracene	8500	13000	<330	<330	41000
Di-n-Butyl phthalate	<5000	<10000	<330	<330	<10000

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

8270 Compounds	F0120 2110 ug/ext	F0121 1228 ug/ext	F0127 1130 ug/ext	F0129 1430 ug/ext	Q0114 1545FMSK ug/ext
Fluoranthene	13000	18000	<330	<330	36000
Pyrene	12000	23000	<330	<330	15000
Butyl benzyl phthalate	<5000	<10000	<330	<330	<10000
3,3'-Dichlorobenzidine	<10000	<20000	<670	<670	<20000
Benzo(a)anthracene	5800	<10000	<330	<330	<10000
Bis(2-ethylhexyl)phthalate	<5000	<10000	<330	<330	<10000
Chrysene	5700	<10000	<330	<330	<10000
Di-n-octyl phthalate	<5000	<10000	<330	<330	<10000
Benzo(b)fluoranthene	<5000	11000	<330	<330	<10000
Benzo(k)fluoranthene	<5000	<10000	<330	<330	<10000
Benzo(a)pyrene	<5000	<10000	<330	<330	<10000
Indeno(1,2,3-cd)pyrene	<5000	29000	<330	<330	<10000
Dibenzo(a,h)anthracene	<5000	<10000	<330	<330	<10000
Benzo(g,h,i)perylene	<5000	<10000	<330	<330	<10000
alpha-BHC	<5000	<10000	<330	<330	<10000
beta-BHC	<5000	<10000	<330	<330	<10000
gamma-BHC	<5000	<10000	<330	<330	<10000
delta-BHC	<5000	<10000	<330	<330	<10000
Heptachlor	<5000	<10000	<330	<330	<10000
Aldrin	<5000	<10000	<330	<330	<10000
Heptachlor epoxide	<5000	<10000	<330	<330	<10000
Endosulfan I	<5000	<10000	<330	<330	<10000
Dieldrin	<5000	<10000	<330	<330	<10000
4,4'-DDE	<5000	<10000	<330	<330	<10000
Endrin	<5000	<10000	<330	<330	<10000
Endosulfan II	<5000	<10000	<330	<330	<10000
4,4'-DDD	<5000	<10000	<330	<330	<10000
Endrin aldehyde	<5000	<10000	<330	<330	<10000
Endosulfan sulfate	<5000	<10000	<330	<330	<10000
4,4'-DDT	<5000	<10000	<330	<330	<10000
PCBs	<5000	<10000	<330	<330	<10000
Date Analyzed	3/20/88	3/20/88	3/21/88	3/21/88	3/20/88

Surrogates	Percent Recovery (%)				
Octafluorobiphenyl	91	96	99	103	83
9-Phenylanthracene	89	96	117	53	78

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

8270 Compounds	Q0127 1130FMSK ug/ext	B1209 1700 ug/ext
Phenol	<3300	<20
Bis(2-chloroethyl)ether	<3300	<20
2-Chlorophenol	<3300	<20
1,3-Dichlorobenzene	<3300	<20
1,4-Dichlorobenzene	<3300	<20
1,2-Dichlorobenzene	<3300	<20
Bis(2-chloroisopropyl)ether	<3300	<20
N-Nitroso-di-n-propylamine	<3300	<20
Hexachloroethane	7400	<20
Nitrobenzene	<3300	<20
Isophorone	<3300	<20
2-Nitrophenol	<3300	<20
2,4-Dimethylphenol	<3300	<20
Bis(2-chloroethoxy)methane	<3300	<20
2,4-Dichlorophenol	<3300	<20
1,2,4-Trichlorobenzene	<3300	<20
Naphthalene	38000	<20
Hexachlorobutadiene	<3300	<20
4-Chloro-3-methylphenol	<3300	<20
Hexachlorocyclopentadiene	<3300	<20
2,4,6-Trichlorophenol	<3300	<20
2-Chloronaphthalene	<3300	<20
Dimethyl phthalate	<3300	<20
Acenaphthylene	34000	<20
Acenaphthene	<3300	<20
2,4-Dinitrophenol	<17000	<100
4-Nitrophenol	<17000	<100
2,4-Dinitrotoluene	<3300	<20
2,6-Dinitrotoluene	<3300	<20
Diethyl phthalate	<3300	<20
4-Chlorophenyl phenylether	<3300	<20
Fluorene	30000	<20
4,6-Dinitro-2-methylphenol	<17000	<100
N-Nitrosodiphenylamine	<3300	<20
4-Bromophenyl phenylether	<3300	<20
Hexachlorobenzene	<3300	<20
Pentachlorophenol	<17000	<100
Phenanthrene	32000	<20
Anthracene	36000	<20
Di-n-Butyl phthalate	<3300	<20

Table 1. Semivolatile Organic Results (Continued)

Acurex Sample ID

8270 Compounds	Q0127 1130FMSK ug/ext	B1209 1700 ug/ext
Fluoranthene	23000	<20
Pyrene	<3300	<20
Butyl benzyl phthalate	<3300	<20
3,3'-Dichlorobenzidine	<6700	<40
Benzo(a)anthracene	<3300	<20
Bis(2-ethylhexyl)phthalate	<3300	<20
Chrysene	<3300	<20
Di-n-octyl phthalate	<3300	<20
Benzo(b)fluoranthene	<3300	<20
Benzo(k)fluoranthene	<3300	<20
Benzo(a)pyrene	<3300	<20
Indeno(1,2,3-cd)pyrene	<3300	<20
Dibenzo(a,h)anthracene	<3300	<20
Benzo(g,h,i)perylene	<3300	<20
alpha-BHC	<3300	<20
beta-BHC	<3300	<20
gamma-BHC	<3300	<20
delta-BHC	<3300	<20
Heptachlor	<3300	<20
Aldrin	<3300	<20
Heptachlor epoxide	<3300	<20
Endosulfan I	<3300	<20
Dieldrin	<3300	<20
4,4'-DDE	<3300	<20
Endrin	<3300	<20
Endosulfan II	<3300	<20
4,4'-DDD	<3300	<20
Endrin aldehyde	<3300	<20
Endosulfan sulfate	<3300	<20
4,4'-DDT	<3300	<20
PCBs	<3300	<20
Date Analyzed	3/20/88	3/17/88

Surrogates	Percent Recovery (%)	
Octafluorobiphenyl	102	14
9-Phenylanthracene	90	85

Table 2. Other Identified Compounds

Acurex Sample ID

	S0114	S0120	S0127	S0129	E0114
	1400	1535	1130	1155	1400
Semivolatile Compounds	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Benzyl alcohol	ND	14	ND	ND	ND
2-Methynapthalene	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND
4-Methylphenol	ND	ND	ND	ND	ND
Unknown hydrocarbons	140	200	320	270	650
Unknown PNA's	ND	ND	ND	ND	ND
Unknown fatty acid esters	230	1700	34	190	1000
Unknown phthalates	110	290	1700	2900	320
Other unknowns	240	580	500	67	140
Unknown siloxanes	ND	1100	1800	330	ND
Unknown alcohols	ND	120	21	ND	ND
Benzaldehyde	ND	48	30	ND	40
Ethylbenzaldehyde	ND	ND	ND	ND	ND
1,3,5-Trichlorobenzene	ND	ND	ND	ND	ND
1,2,3,5-Tetrachlorobenzene	ND	ND	ND	ND	ND

ND - Not detected among the major peaks examined, detection limit unknown.

The above compounds (idents) are reported at the client's request. They were identified and quantitated by the following procedure:

After identification and quantitation of the target compounds, the 20 most intense peaks remaining in the chromatogram are selected for examination. The spectra for these peaks are compared by computer with a National Bureau of Standards library containing 42,000 entries. A chemist trained in mass spectral interpretation then examines the results. Since at the outset these peaks are unknown, no standards are usually analyzed to obtain retention time or response factor data. Quantitation is based on a comparison of the area of the reconstructed ion chromatogram from the unknown peak and the nearest internal standard. This follows the EPA CLP protocol.

Table 2. Other Identified Compounds (Continued)

Acurex Sample ID

Semivolatile Compounds	E0120 1535T1 ug/ext	E0120 1535T2 ug/ext	E0121 1230T1 ug/ext	E0121 1230T2 ug/ext	E0127 1130 ug/ext
Benzyl alcohol	ND	ND	ND	ND	ND
2-Methynapthalene	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND
4-Methylphenol	ND	ND	ND	ND	ND
Unknown hydrocarbons	970	180	490	500	1050
Unknown PNA's	ND	ND	ND	ND	ND
Unknown fatty acid esters	400	170	590	310	430
Unknown phthalates	98	56	89	170	36
Other unknowns	170	130	110	250	120
Unknown siloxanes	ND	1000	95	22	ND
Unknown alcohols	ND	49	63	35	100
Benzaldehyde	42	24	ND	31	38
Ethylbenzaldehyde	ND	ND	ND	19	13
1,3,5-Trichlorobenzene	ND	ND	ND	ND	21
1,2,3,5-Tetrachlorobenzene	ND	ND	ND	ND	17

ND - Not detected among the major peaks examined, detection limit unknown.

The above compounds (idents) are reported at the client's request. They were identified and quantitated by the following procedure:

After identification and quantitation of the target compounds, the 20 most intense peaks remaining in the chromatogram are selected for examination. The spectra for these peaks are compared by computer with a National Bureau of Standards library containing 42,000 entries. A chemist trained in mass spectral interpretation then examines the results. Since at the outset these peaks are unknown, no standards are usually analyzed to obtain retention time or response factor data. Quantitation is based on a comparison of the area of the reconstructed ion chromatogram from the unknown peak and the nearest internal standard. This follows the EPA CLP protocol.

Table 2. Other Identified Compounds (Continued)

Acurex Sample ID

Semivolatile Compounds	E0129 1155 ug/ext	B0114 1800 ug/ext	B0120 2100 ug/ext	B0121 1220 ug/ext	B0127 1600 ug/ext
Benzyl alcohol	ND	ND	ND	ND	ND
2-Methynapthalene	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND
4-Methylphenol	ND	ND	ND	ND	ND
Unknown hydrocarbons	560	ND	ND	ND	ND
Unknown PNA's	ND	ND	ND	ND	ND
Unknown fatty acid esters	430	36	110	280	400
Unknown phthalates	2030	ND	ND	ND	ND
Other unknowns	240	31	24	50	53
Unknown siloxanes	ND	ND	ND	ND	ND
Unknown alcohols	56	11	ND	ND	ND
Benzaldehyde	ND	ND	ND	ND	ND
Ethylbenzaldehyde	ND	ND	ND	ND	ND
1,3,5-Trichlorobenzene	ND	ND	ND	ND	ND
1,2,3,5-Tetrachlorobenzene	ND	ND	ND	ND	ND

ND - Not detected among the major peaks examined, detection limit unknown.

The above compounds (idents) are reported at the client's request. They were identified and quantitated by the following procedure:

After identification and quantitation of the target compounds, the 20 most intense peaks remaining in the chromatogram are selected for examination. The spectra for these peaks are compared by computer with a National Bureau of Standards library containing 42,000 entries. A chemist trained in mass spectral interpretation then examines the results. Since at the outset these peaks are unknown, no standards are usually analyzed to obtain retention time or response factor data. Quantitation is based on a comparison of the area of the reconstructed ion chromatogram from the unknown peak and the nearest internal standard. This follows the EPA CLP protocol.

Table 2. Other Identified Compounds (Continued)

Acurex Sample ID

Semivolatile Compounds	B0129 1430 ug/ext	T0114 1345 ug/ext	T0120 1535 ug/ext	T0121 1200 ug/ext	T0127 1130 ug/ext
Benzyl alcohol	ND	ND	ND	ND	ND
2-Methynapthalene	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND
4-Methylphenol	ND	ND	ND	ND	ND
Unknown hydrocarbons	ND	ND	ND	ND	ND
Unknown PNA's	ND	ND	ND	ND	ND
Unknown fatty acid esters	74	190	26	16	190
Unknown phthalates	ND	ND	ND	ND	ND
Other unknowns	52	ND	10	ND	ND
Unknown siloxanes	ND	ND	ND	ND	ND
Unknown alcohols	ND	ND	ND	ND	ND
Benzaldehyde	ND	ND	ND	ND	ND
Ethylbenzaldehyde	ND	ND	ND	ND	ND
1,3,5-Trichlorobenzene	ND	ND	ND	ND	ND
1,2,3,5-Tetrachlorobenzene	ND	ND	ND	ND	ND

ND - Not detected among the major peaks examined, detection limit unknown.

The above compounds (idents) are reported at the client's request. They were identified and quantitated by the following procedure:

After identification and quantitation of the target compounds, the 20 most intense peaks remaining in the chromatogram are selected for examination. The spectra for these peaks are compared by computer with a National Bureau of Standards library containing 42,000 entries. A chemist trained in mass spectral interpretation then examines the results. Since at the outset these peaks are unknown, no standards are usually analyzed to obtain retention time or response factor data. Quantitation is based on a comparison of the area of the reconstructed ion chromatogram from the unknown peak and the nearest internal standard. This follows the EPA CLP protocol.

Table 2. Other Identified Compounds (Continued)

	Acurex Sample ID				
	T0129 1155	Q0114 1028FSK	Q0114 1020FBK	Q0120 0841FBK	Q0120 0848FSK
Semivolatile Compounds	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Benzyl alcohol	ND	ND	ND	ND	ND
2-Methynapthalene	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND
4-Methylphenol	ND	ND	ND	ND	ND
Unknown hydrocarbons	ND	220	170	120	300
Unknown PNA's	ND	ND	ND	ND	ND
Unknown fatty acid esters	ND	250	290	82	200
Unknown phthalates	ND	ND	ND	ND	ND
Other unknowns	ND	100	180	44	170
Unknown siloxanes	ND	ND	ND	ND	ND
Unknown alcohols	ND	ND	ND	30	60
Benzaldehyde	ND	ND	ND	ND	ND
Ethylbenzaldehyde	ND	ND	ND	ND	ND
1,3,5-Trichlorobenzene	ND	ND	ND	ND	ND
1,2,3,5-Tetrachlorobenzene	ND	ND	ND	ND	ND

ND - Not detected among the major peaks examined, detection limit unknown.

The above compounds (idents) are reported at the client's request. They were identified and quantitated by the following procedure:

After identification and quantitation of the target compounds, the 20 most intense peaks remaining in the chromatogram are selected for examination. The spectra for these peaks are compared by computer with a National Bureau of Standards library containing 42,000 entries. A chemist trained in mass spectral interpretation then examines the results. Since at the outset these peaks are unknown, no standards are usually analyzed to obtain retention time or response factor data. Quantitation is based on a comparison of the area of the reconstructed ion chromatogram from the unknown peak and the nearest internal standard. This follows the EPA CLP protocol.

Table 2. Other Identified Compounds (Continued)

Acurex Sample ID

Semivolatile Compounds	Q0121 0836FBK ug/ext	Q0127 0830FSK ug/ext	Q0127 0829FBK ug/ext	Q0129 0730FSK ug/ext	Q0129 0731FBK ug/ext
Benzyl alcohol	ND	ND	ND	ND	ND
2-Methynapthalene	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND
4-Methylphenol	ND	ND	ND	ND	ND
Unknown hydrocarbons	74	300	460	280	29
Unknown PNA's	ND	ND	ND	ND	ND
Unknown fatty acid esters	510	60	60	630	80
Unknown phthalates	ND	ND	ND	17	ND
Other unknowns	25	160	110	490	50
Unknown siloxanes	ND	ND	ND	ND	ND
Unknown alcohols	68	ND	ND	ND	ND
Benzaldehyde	ND	ND	ND	ND	ND
Ethylbenzaldehyde	ND	ND	ND	ND	ND
1,3,5-Trichlorobenzene	ND	ND	ND	ND	ND
1,2,3,5-Tetrachlorobenzene	ND	ND	ND	ND	ND

ND - Not detected among the major peaks examined, detection limit unknown.

The above compounds (idents) are reported at the client's request. They were identified and quantitated by the following procedure:

After identification and quantitation of the target compounds, the 20 most intense peaks remaining in the chromatogram are selected for examination. The spectra for these peaks are compared by computer with a National Bureau of Standards library containing 42,000 entries. A chemist trained in mass spectral interpretation then examines the results. Since at the outset these peaks are unknown, no standards are usually analyzed to obtain retention time or response factor data. Quantitation is based on a comparison of the area of the reconstructed ion chromatogram from the unknown peak and the nearest internal standard. This follows the EPA CLP protocol.

Table 2. Other Identified Compounds (Continued)

Acurex Sample ID

Semivolatile Compounds	Q0127 1130TSK	Q0120 1535TSK	Q0120 2100BSK	Q0127 1600BSK	F0114 1545
	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Benzyl alcohol	ND	ND	ND	ND	ND
2-Methynapthalene	ND	ND	ND	ND	5200
Dibenzofuran	ND	ND	ND	ND	5800
4-Methylphenol	ND	ND	ND	ND	650
Unknown hydrocarbons	ND	ND	ND	27	ND
Unknown PNA's	ND	ND	ND	ND	13000
Unknown fatty acid esters	ND	10	380	430	ND
Unknown phthalates	ND	ND	ND	ND	ND
Other unknowns	ND	ND	250	270	ND
Unknown siloxanes	ND	ND	ND	ND	ND
Unknown alcohols	ND	ND	23	ND	ND
Benzaldehyde	ND	ND	ND	ND	ND
Ethylbenzaldehyde	ND	ND	ND	ND	ND
1,3,5-Trichlorobenzene	ND	ND	ND	ND	ND
1,2,3,5-Tetrachlorobenzene	ND	ND	ND	ND	ND

ND - Not detected among the major peaks examined, detection limit unknown.

The above compounds (idents) are reported at the client's request. They were identified and quantitated by the following procedure:

After identification and quantitation of the target compounds, the 20 most intense peaks remaining in the chromatogram are selected for examination. The spectra for these peaks are compared by computer with a National Bureau of Standards library containing 42,000 entries. A chemist trained in mass spectral interpretation then examines the results. Since at the outset these peaks are unknown, no standards are usually analyzed to obtain retention time or response factor data. Quantitation is based on a comparison of the area of the reconstructed ion chromatogram from the unknown peak and the nearest internal standard. This follows the EPA CLP protocol.

Table 2. Other Identified Compounds (Continued)

	Acurex Sample ID				
	F0120 2110	F0121 1228	F0127 1130	F0129 1430	Q0114 1545FMSK
Semivolatile Compounds	ug/ext	ug/ext	ug/ext	ug/ext	ug/ext
Benzyl alcohol	ND	ND	ND	ND	ND
2-Methynapthalene	5000	7900	ND	ND	5500
Dibenzofuran	5800	8900	ND	ND	6400
4-Methylphenol	ND	ND	ND	ND	ND
Unknown hydrocarbons	ND	ND	ND	ND	ND
Unknown PNA's	15000	4800	ND	ND	ND
Unknown fatty acid esters	ND	ND	ND	180	ND
Unknown phthalates	ND	ND	ND	ND	ND
Other unknowns	ND	ND	ND	ND	ND
Unknown siloxanes	ND	ND	ND	ND	ND
Unknown alcohols	ND	ND	ND	ND	ND
Benzaldehyde	ND	ND	ND	ND	ND
Ethylbenzaldehyde	ND	ND	ND	ND	ND
1,3,5-Trichlorobenzene	ND	ND	2200	2200	ND
1,2,3,5-Tetrachlorobenzene	ND	ND	ND	ND	ND

ND - Not detected among the major peaks examined, detection limit unknown.

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After identification and quantitation of the target compounds, the 20 most intense peaks remaining in the chromatogram are selected for examination. The spectra for these peaks are compared by computer with a National Bureau of Standards library containing 42,000 entries. A chemist trained in mass spectral interpretation then examines the results. Since at the outset these peaks are unknown, no standards are usually analyzed to obtain retention time or response factor data. Quantitation is based on a comparison of the area of the reconstructed ion chromatogram from the unknown peak and the nearest internal standard. This follows the EPA CLP protocol.

Table 2. Other Identified Compounds (Continued)

Acurex Sample ID

Semivolatile Compounds	Q0127 1130FMSK ug/ext	B1209 1700 ug/ext
Benzyl alcohol	ND	ND
2-Methynapthalene	ND	ND
Dibenzofuran	ND	ND
4-Methylphenol	ND	ND
Unknown hydrocarbons	ND	ND
Unknown PNA's	ND	ND
Unknown fatty acid esters	ND	100
Unknown phthalates	ND	ND
Other unknowns	ND	71
Unknown siloxanes	ND	ND
Unknown alcohols	ND	ND
Benzaldehyde	ND	ND
Ethylbenzaldehyde	ND	ND
1,3,5-Trichlorobenzene	15000	ND
1,2,3,5-Tetrachlorobenzene	ND	ND

ND - Not detected among the major peaks examined, detection limit unknown.

The above compounds (idents) are reported at the client's request. They were identified and quantitated by the following procedure:

After identification and quantitation of the target compounds, the 20 most intense peaks remaining in the chromatogram are selected for examination. The spectra for these peaks are compared by computer with a National Bureau of Standards library containing 42,000 entries. A chemist trained in mass spectral interpretation then examines the results. Since at the outset these peaks are unknown, no standards are usually analyzed to obtain retention time or response factor data. Quantitation is based on a comparison of the area of the reconstructed ion chromatogram from the unknown peak and the nearest internal standard. This follows the EPA CLP protocol.

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